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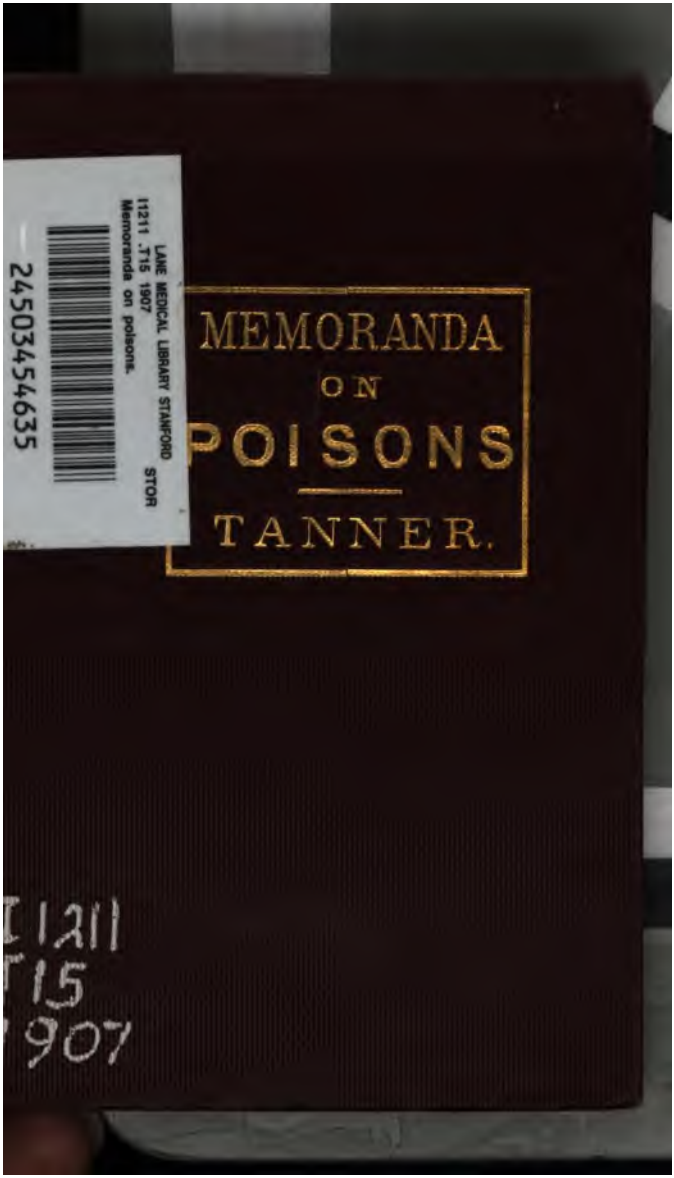
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POISONS

BY

THOMAS HAWKES TANNER, M. D., F. L. S.

TENTH REVISED EDITION.

BY

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PUBLISHERS' NOTE.

TENTH EDITION.

The necessity of reprinting another edition of this very popular little manual presented the opportunity for revision. Without materially increasing the size, the editor has been able to insert new matters including formaldehyde poisoning and antidotal methods for snake bites. The changes made in the former revision by the substitution of modern chemical nomenclature and the omission of obsolete portions of the text, seem to have met with general approval. The toxicology of poisonous food has been presented as fully as the concise character of the book allows. As the work is intended for those engaged in actual medical practice, and not for medico-legal reference, most of the English cases given in the original have been omitted.

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INTRODUCTION.

CHAPTER I.

DEFINITION AND MODE OF ACTION OF POISONS.

TOXICOLOGY is that branch of medical science which treats of the nature, properties, effects and detection of poisons.

DEFINITION OF A POISON.—It is impossible to give a definition that will bear critical examination. Most substances are poisonous in certain doses, which need not be always very large; even common salt has caused death. A poison may be defined to be any substance which, when absorbed into the fluids of the body, produces such disturbance of function as imperils life. A cherrystone may cause death by becoming arrested in the vermiform appendix, and thus producing peritonitis; boiling water may cause death also; but neither are poisons, the one acting mechanically, the other by its heat merely.

THE LAW REGARDING POISONS.—Any substance which can injure the health or destroy life is usually regarded as a poison, if given with the intent to do mischief; but the

laws in regard to poisoning differ much in different countries.

ADMINISTRATION OF POISONS.—Poisons may be introduced into the body in various ways, and in various forms. Thus, they may be administered by the mouth, rectum, vagina, or lungs, or underneath the skin; and they may be given in the form of solids, liquids, or gases alone, or mixed with various matters.

Some agents are more readily absorbed than others, whilst some textures permit of absorption taking place more quickly through them than other tissues. Hence the most diffusible poisons prove most rapidly fatal, especially when introduced directly into the circulation by a wound in a blood vessel or lymphatic, or when they are injected into the subcutaneous connective tissue. Their action is especially speedy when applied in a gaseous state to the pulmonary air-cells; but less so as a fluid to the stomach or intestines. The serous membranes, such as the peritoneum, possess an activity of absorption superior to that of the mucous membranes, while absorption through the unbroken skin is slow, on account of the partially impermeable cuticle. Poisons taken into the stomach when that organ is empty, being less diluted, act much more speedily than when it is full. It is remarkable that the agents which most affect the nervous system do not appear to act at all when applied directly to the brain or the trunks of nerves. There are also some poisons, as curara and snake poison, which, although most deadly

when introduced into the blood through a wound, are comparatively harmless when swallowed. This is true of the animal poisons generally; they appear to undergo a species of digestion.

The effects of poisons may be considered as **local** and **remote.**

The **local** effects of poisons may be due to ordinary chemical action, or to the specific action of the substance employed, and these are unfortunately various.

THE LOCAL EFFECTS OF POISONS.—The local effects are mainly of three kinds, viz:

Corrosion, or chemical decomposition, as is seen in the effects of the strong mineral acids and alkalies.

Irritation or **Inflammation,** varying from simple redness, in its mildest, to ulceration and gangrene in its most severe degree, as may result from the use of corrosive sublimate.

A local specific effect, produced on the sentient extremities of the nerves, as is felt on the local application of prussic acid, aconite, etc.

THE REMOTE EFFECTS OF POISON.—The **remote** effects are those influencing organs at some distance from the part to which the poison has been applied. These may be either common or specific.

Common, such as the constitutional indications of fever, however produced.

Specific, like the effects of opium in contracting the pupil, producing constipation, etc., over and above its local influence in relieving pain.

Many narcotic poisons produce but little local change, though their remote effects are very remarkable. For example, belladonna, in whatever way it may be introduced into the system, by swallowing, hypodermic injection, or direct application to the eyeball, paralyzes the ciliary nerves, and so causes dilatation of the pupil, and accommodation for distant vision.

Many substances have both a **local** and **remote** action, as is well seen in the influence of cantharides upon the part to which they are applied, in producing blisters, and their remote effects upon the urinary organs, there producing strangury, and sometimes bloody urine.

The **remote** action of a poison may be said, according to the views now prevalent, to be due in every instance to its **absorption** either into the veins or the lymphatics, except where there is a direct continuity of effect traceable from the point where the poison was applied, to the point where the remote effect is shown. The part played by the nerves in producing the remote effect of a poison is not clear, but undoubtedly many of the symptoms recorded in anomalous cases of poisoning have been due to their influence. To illustrate what is meant, the great tendency to convulsions of *various kinds* in many cases of poisoning mig-

be cited. This is just what is seen in ordinary practice, where a local irritation may give rise to reflex phenomena of various kinds, but if very intense, or occurring in a neurotic subject, may induce convulsions: witness the convulsions of teething and of worms.

It is not worth while to describe here the various experiments by which the absorption of poisons into the circulation has been proved; the fact may be taken for granted, since they have been discovered in the blood, in the various secretions, and in the solids of the body, after administration. Nevertheless, it is well to bear in mind that certain substances affect certain organs in particular, even when they influence or attack more than one. Thus, to give a few examples: opium (morphin) and alcohol specially affect the brain; strychnin, the spinal cord; curara, the motor system of nerves; digitalis, the heart; stramonium, the lungs; antimony and arsenic, the stomach; mercury, the liver; cantharides, the urinary organs; ergot, the uterus; and so on. In all of them the action is complex, yet the organs named seem to be specially selected for the production of their respective effects.

Let it not be forgotten that a patient may die from the shock of a dose of a powerful poison, as he may from the shock of a mechanical injury.

MODIFICATION OF THE ACTION OF POISONS.—The same poison does not invariably act in the same way even when a number of people are attacked at the same time.

By far the most important of the modifying agencies is the **quantity** or **dose.** Many substances which are deadly in large doses are exceedingly useful as remedies in small quantities; such are prussic acid, opium, digitalis, arsenic, etc. Then again the **mechanical stage** of aggregation is of consequence; a solid being usually much less active than a fluid or a gas, and a pure and soluble substance much more active than one mixed with foreign insoluble materials. Even more important is the **chemical constitution** of the poisonous agent. As already pointed out, poisonous effects result from absorption of the poisoning body, and absorption implies solution; the more soluble, therefore, the compound is, the more speedy are its effects, whilst compounds insoluble in water, or any of the juices of the body, are inert. It is not, however, enough that the substance be insoluble in water; it must be so also in the gastric juice and other digestive fluids, or it may give rise to characteristic symptoms. Thus, calomel is insoluble in water, yet it is a powerful medicine; orpiment is insoluble in water, yet, when swallowed, it may give rise to symptoms of arsenical poisoning, and so on. The **mental** and **bodily condition** of the recipient must also be taken into account. Thus, in excited maniacs, and in certain convulsive disorders, doses of sedatives which in ordinary individuals might result seriously, may be given, without producing any effect. The bodily condition, especially as influenced by habit, is still more im-

portant. It may be broadly stated, that by gradually increasing the dose of a substance ordinarily poisonous, in course of time enormous quantities may be borne without producing immediate ill effects. This is especially seen in the practice of opium-eating and smoking, and in less degree in arsenic-eating, as practiced in Styria. The latter instance is, however contrary to the usual rule; for whereas with vegetable substances, such as opium, the dose requires to be constantly increased to keep up the effects, with minerals the contrary seems to be the case, especially with antimony and mercury, which cannot be long given without danger to the recipient.

CHAPTER II.

THE DIAGNOSIS OF POISONING.

THE chief characteristics of poisoning are that the symptoms commence suddenly, not long after swallowing any substance, the individual being, up at that time, in health; that these symptoms progress steadily, are nearly uniform throughout their course, and prove more or less speedily fatal.

There are many exceptions to these rules. Thus, if the stomach be loaded, the appearance of the symptoms may be delayed some hours. Intoxication will mask the effect of narcotics. Again, the individual poisoned may possibly be suffering from disease, and an agent may be given which will only aggravate

existing symptoms, not produce new ones. The fact must not be forgotten that sometimes a poisonous draught is substituted for a harmless medicine. Lastly, after a poison has manifested its effects, the symptoms may remit for a time.

When poison is administered with a criminal intent, it is generally in such a dose as to produce prompt effect, although this is by no means necessary, as there are numerous substances, notably antimony compounds and arsenic, which accumulate in the system, and when given in small and repeated quantities, ultimately prove fatal. In diagnosing a case of suspected poisoning from the symptoms only, it is of the utmost importance not to comfound these with the signs of diseases which they frequently closely resemble; thus, cholera, internal hemorrhage from the bursting of an aneurism, etc., commence suddenly, and run rapidly to a fatal termination. In inflammation of the stomach or intestines, especially from improper food, the symptoms often set in suddenly, and might be mistaken for poisoning; such is also the case in intestinal obstruction, and in ulceration and perforation of the bowels, as may occur in latent typhoid fever. In organic diseases of the heart, in which the symptoms may have remained latent for some time, death often occurs suddenly from syncope. The diagnosis of the effects of irritant poisons is not so difficult as it is in the case of narcotics or other neurot-

ics, in which the symptoms are very similar to those produced by apoplexy, epilepsy, tetanus, convulsions, or other forms of disease of the brain.

Generally speaking, a person may be supposed to be suffering under the effects of a poison if soon after taking food or drink, he be seized with violent pain, vomiting, purging, and convulsions, or if he be attacked under the same circumstances with delirium or great drowsiness. It must not be forgotten, however, that poisons may be introduced into the body, not only by the mouth, along with food and drink, but also by means of suppositories, enemata, or vaginal injections, by inhalation, by subcutaneous injection, or through the true skin after the removal of the cuticle.

Should death ensue, the presumption of criminal intent will, of course, be strengthened by the discovery of post-mortem appearances similar to those known to be produced by the poison from which the person apparently suffered.

The post-mortem appearances, however, except in a few instances, are not very characteristic; and the fact that these often strikingly resemble the post-mortem results of disease should suggest great caution in the diagnosis, especially in the case of suspected criminal poisoning; nevertheless, they may be of great negative value in proving that a certain poison has not been administered, or that the patient died from the effects of disease.

The detection of poison in some of the food which has been left untaken, or in the matters vomited, would seem to be conclusive evidence of the administration of poison; but it is to be recollected that designing persons have mixed noxious materials with food, vomited matters, or feces, in order to feign poisoning, or to cast unjust imputations upon others, and it is quite possible that a patient, after having taken poison, may die from natural causes.

In a fatal case, especially of criminal poisoning, proof of the presence of poison is very important. The previous symptoms, together with the post-mortem appearances, although affording strong corroborative evidence, may not be sufficient of themselves to establish the fact. In all such cases the further proof afforded by a careful chemical analysis will be required. This will be attended to subsequently.

Naturally, the stomach and its contents demand the first investigation. It may happen that in a fatal case not a vestige of the poison may be discovered in the stomach after death. This may occur where the dose has not been over large, and when the patient has survived long enough to allow of its removal by absorption. Then it must be searched for in the liver and other viscera. Indeed, whether discovered in the stomach or not, this further examination of the viscera is always necessary, because of the presence of the poison in the stomach is not **absolute** proof that the death

was caused by poisoning, since it is always possible that it might have been produced by some other intercurrent cause, such as sudden apoplexy, heart failure, rupture of an aneurism, or of a gastric ulcer, etc. Besides, there is the further possibility that the poison may have been surreptitiously introduced therein after death, for a sinister purpose.

Furthermore, although the detection of the poison in the liver, etc., is, in the majority of cases, usually regarded as very positive proof of death from poisoning, nevertheless it is not invariably so. For it is now generally recognized by toxicologists that a poisonous liquid may be injected into a body after death, either into the stomach or rectum, by means of a tube, and after a short time this poison will find its way into the neighboring viscera through simple imbibition, or osmosis, and so contaminate these viscera as to render it exceedingly difficult, if not impossible, to distinguish between such a case and one of real ante-mortem poisoning. Still further, it may happen that the injection into the body after death of a poisonous fluid, such as a solution of corrosive sublimate, or arsenic, etc., for the purpose of preservation (embalming) may by this same imbibition be diffused into the different adjacent viscera, and so give rise to serious difficulties in a subsequent investigation. Cases of this nature are known to have occurred.

Another fact to be remembered in connection with the chemical detection of a poison is, that there are vegetable and animal poisons, for which there is no positive chemical test. For the detection of these other means may be applied. **Physiological proof,** or that afforded by experiments on living animals, is often utilized for this purpose. The suspected vomited matters (or the remains of the food and drink, if they can be obtained) are injected through a tube into the stomach of some animal, such as a dog, cat, rabbit or guinea pig, and the effects closely watched, and compared with those produced upon other healthy animals of the same nature, by some of the pure suspected poison. If this be impossible, or if the examiner be confined in his researches to the minute ultimate extract obtained from the stomach of the deceased, this minute residuum may be introduced hypodermically into the body of a very small animal, as a mouse or small bird, and its effects noticed and compared as above mentioned. In the case of aconite poisoning, a drop or two of the ultimate extract placed upon the tongue will produce the characteristic tingling sensation of that drug.

In all such cases as those above mentioned where the usual chemical analysis fails, the experimenter may resort to the physiological proof if practicable.

CHAPTER III.

THE DUTIES OF THE PRACTITIONER IN CASES OF POISONING.

WHEN called to attend a case of supposed poisoning the practitioner's duty is two-fold:

I. HIS FIRST AIM MUST BE TO PRESERVE LIFE.

II. HIS SECOND, TO FORWARD THE INTEREST OF JUSTICE.

If he reaches the spot too late to save life, his duties are undivided, for he has but to see that justice is done; and in order that there be no failure in this respect, it is important that all his observations should be made as carefully as possible, and **committed as speedily as possible to writing.**

He should:

1. Inquire as to the time at which any substance was last taken by the sufferer;

2. The nature of the symptoms, observed from the beginning of the illness onwards;

3. The hour at which they commenced; and

4. The precise time at which death occurred.

5. He must take possession of any **food, medicine, vomited matters, urine,** or **feces** which may be in the room, and he is to seal them up in **new** and **clean** vessels, duly labeled for examination. No old pickle-jars or bottles, nor anything of the kind, must be used. Then the **position** and **temperature** of the body are to be observed, the appearance of the **countenance,** the presence or absence of **rigor mortis,**

with the **nature** and **warmth** of the apartment, the situation of any **marks** of **violence,** or of any stains, and the condition of the inside of the **mouth** and **gullet.**

POST-MORTEM EXAMINATIONS.—In addition to the ordinary rules to be observed in conducting **post-mortem examinations,** something more must be done, in cases of suspected poisoning, with a view to preserving portions of the body for subsequent examination. The alimentary canal is the most important organ to be thus secured, and it should be removed in separate portions. A double ligature should be passed around the esophagus in the chest, and the duodenum a few inches below the pylorus should be secured in like manner; by cutting across the gullet and intestines between these ligatures, the stomach may be removed without any danger of spilling its contents. It is best to open the stomach as soon as possible after its removal from the body, so that its pathological condition may be noted as early as possible. Another ligature should be tied low down in the rectum, and the intestines removed and introduced into a separate vessel prepared for them, and then examined like the stomach. Sometimes it may be necessary to remove the gullet in like fashion. As much blood as possible should be saved for the chemist, and a portion of the liver, if not the whole organ, should also be secured. When everything has been tied up, the jars should be **sealed, numbered, labelled,** and **initialed,** to *prevent* subsequent confusion and to facilitate

identification. In women, the vagina, uterus and ovaries must be inspected. The brain, spinal cord, and thoracic viscera ought likewise to be examined, and portions of these organs, together with the spleen, kidneys and pieces of the muscles, should be reserved for analysis. When possible, it will be best to make the autopsy within twenty-four hours after death, taking care to make the examination patiently, thoroughly, and with a mind free from any bias. For poison may be found in a body, and yet a question may arise as to its having been the cause of death. Hence, in these investigations every organ of the body is to be examined, in order to learn whether any disease has existed to a sufficient extent to account for the fatal result.

The addition of preservatives should be avoided, if possible. If needed, formaldehyd is probably the best. A portion of the preservative should be kept separate in order to be tested as to its purity.

CHAPTER IV.

TREATMENT OF POISONING.

WHEN the practitioner is called in to a case of poisoning, he must set himself to preserve life in whatever way he best can. In this, of course, he must be guided by circumstances, but several broad rules may be laid down. All have one end, but the order may be varied.

This is the first rule—

NEVER WAIT FOR A REMEDY, HOWEVER

PERFECT, IF AN IMPERFECT ONE IS AT HAND. THAT IS BEST WHICH IS READIEST, the grand rule being, TO LOSE NO TIME.

Most of the modes of treatment come under one or other of the four following heads:—

I. GET RID OF THE POISON.
II. STOP ITS ACTION.
III. REMEDY THE MISCHIEF IT HAS DONE.
IV. FIGHT AGAINST THE TENDENCY TO DEATH.

I.—TO GET RID OF THE POISON.

This is ordinarily the first thing to be done, if the poison has been swallowed. To do so, two means may be employed, vomiting or the stomach-tube.

The latter is one of the most certain means we possess of emptying the stomach; and by means of it this viscus may be washed out, and the antidote, if any be known, administered. In speaking hereafter, however, of the treatment to be adopted in each particular instance, it will be seen that there are some cases, such as poisoning by corrosives, in which this instrument cannot be used. It might not only cause laceration of the tissues, but even perforation of the esophagus or stomach, and deliver its contents into the pleura or peritoneum. It is hardly necessary to mention that in all cases a certain knack is required in its employment; the tube having, on more than one occasion, been introduced into the trachea, and the lungs injected with water, etc. It is always best to keep the

point of the tube gently pressed against the back part of the pharynx and esophagus until it reaches the stomach. It is a good rule also to withdraw less fluid than is pumped into the stomach.

Supposing, however, that this instrument is not at hand, or that it is an improper occasion for its employment, two means are available for emptying the stomach—the use of a syphon arrangement, or vomiting, natural or artificial. It will not be amiss to bear in mind the uses of india-rubber tubing in such cases. Fairly thick tubing is easily introduced into the stomach either through the mouth or through the nose. Once introduced, it is likewise, by means of an ordinary funnel, easy to introduce a quantity of lukewarm water through the tube into the stomach, then by placing the patient flat on his face, the tube may be used to empty the fluid contents of that organ. **Vomiting** is, in many instances, one of the first and most important signs of poisoning, especially by irritant substances. When such is the case, it is only necessary to foster the tendency by **copious draughts of lukewarm water;** but if there be no vomiting and the stomach-pump be not at hand, an **emetic** must be given. Of these remedies perhaps there is not one which can be generally used with so much advantage as **zinc sulphate** in 20-grain doses; for not only is it more rapid in its action, but its effects are less depressing than those of any other emetic, except mustard. **Wine of ipecac** (six or eight drams), or a

scruple of powdered **ipecacunanha,** with the same quantity of the ordinary **ammonium carbonate,** may be administered in a wineglassful of water. In the absence of these, **mustard,** as aforesaid, proves an excellent substitute. A teaspoonful or two is to be given in warm water, and frequently repeated. **Common salt** (a handful in a pint of lukewarm water) may be used with good effect. Let it not be forgotten that vomiting may also be excited by **tickling the fauces,** and by the free administration of **warm water.**

When the poison has been applied locally, as in snake bite, to prevent its absorption a ligature must be applied between the trunk and the wounded part, as near the latter as possible, while the deleterious substance is to be removed by free incisions and plentiful washings. Sucking by the mouth or by cupping-glasses may also be employed. The most lamentable class of cases of this kind with which in this country we are acquainted are those resulting from the bite of a mad dog. In all of these the wound should be promptly cauterized by means of strong fuming nitric acid, the fluid being allowed to permeate everywhere, and sodium carbonate or sodium acid carbonate (baking soda), being at hand to neutralize the acid when its work is done. Should this not suffice to arrest the action of the poison, when symptoms appear, the only remedy which, up to the present moment, seems to offer a chance of recovery, is **curare.**

II.—To stop the action of the Poison if it cannot be readily and immediately removed.

The means whereby this is effected is ordinarily the administration of an **antidote.** As no universal antidote is known, the treatment will of course vary with the substance taken.

The most reliable antidotes will be mentioned in connection with each particular poison, as far as specific antidotes are likely to be of service.

An antidote should possess the following properties: It should be capable of being taken in a large dose without danger; it should act upon the poison, whether liquid or solid; it should be capable of combining with the poison immediately, at a temperature equal to or below that of the body; its action should be quick; and lastly, it should deprive the poison of its deleterious properties.

Antidotes mostly operate by forming **harmless** chemical combinations, or by producing **insoluble** compounds, and thus preventing or delaying absorption. In most cases they have no effect upon the constitution. Some antidotes may be looked upon as a kind of counter-poison. Thus, the antagonistic action of chloroform and strychynin seems fairly made out. The antagonism between atropin and morphin is not as generally accepted as formerly.

Animal charcoal, which has been proposed as an antidote, seems to act in a great measure mechanically, but it has also a power of absorbing alkaloids, which may render it use-

ful. Such substances as magnesia and gruel are sometimes, and often most usefully, given with the view of protecting the walls of the stomach.

III.—To remedy the mischief done; and

IV.—Obviate the tendency to death.

Unfortunately, in a great number of instances, too great an interval has elapsed between the exhibition of the poison and the time when the first-mentioned indications can be fully carried into effect; for, as before implied, if absorption has taken place, direct antidotes will be of little avail.

Our object must then be to **palliate the symptoms** as they arise, as well as to **neutralize the effects** of the poison on the constitution, by remedies of an opposite character. Thus, in poisoning by depressing agents (like digitalis) and narcotics (as opium), or such as arrest certain modes of nervous force (as curare), all lowering measures must be avoided, and agents used which will exert a contrary effect, as stimulants, galvanism, etc. Shock must also be taken into account in dealing with such cases. In many forms of poisoning this is too much overlooked, and the only idea which enters the practitioner's head is to get rid of the poison.

Claude Bernard has shown the importance of particularly attending to the way in which poisons destroy life. For example, **curare paralyzes the motor nerves,** puts a stop to *all motion,* suspends respiration, and so brings

on suffocation; yet by keeping up artificial respiration for a sufficient length of time, life may be preserved till the poison is eliminated and the danger over. **Strychnin attacks the sensitive portion of the spinal nervous system;** but if the external excitement which perpetually provokes reflex action, and thereby brings on fatal convulsions, be guarded against, recovery may ensue. A frog poisoned by strychnin rapidly dies if frequently excited; whereas, if left perfectly quiet under a bell glass, it may recover.

Lastly, we must endeavor to promote the elimination of the poison from the body. To give an example, in chronic mercurial and lead poisoning potassium iodid is useful, apparently by rendering the metals more soluble, and so more easily gotten rid of by the kidneys or bowels.

CHAPTER V.

DETECTION OF POISONS.

THE detection of a poison is, in many instances, no easy matter; it should not, therefore, be rashly undertaken, except by one well skilled in the minutiæ of the processes to be adopted; whilst, on the other hand, there are so many points of practical importance which may be noted by the practitioner in charge of a patient suffering from poisoning, that his attention should be specially directed to these. The exact determination of the cause of death

will depend partly on the symptoms noted during life, partly on the appearances found after death. These come within the province of the ordinary practitioner; on the other hand, the special physical, chemical, and physiological portions of the inquiry should be referred to the expert. In a book of this scope it is impossible to give full details with regard to these last, but a brief sketch may be useful.

The **PHYSICAL EXAMINATION**, say, of the contents of the stomach and intestines, should be made at the time of the **post-mortem** examination, or as soon after as possible. The condition and appearances of these organs should be carefully noted at the time, and the notes carefully preserved. Next, the examiner should take heed of the smell, color and general appearance of the matters, contained in these organs. The odor, for instance, may be useful in indicating the presence of prussic acid, of alcohol, of opium, or of phosphorus. The **color** may indicate the presence of salts of copper, of fragments of cantharides, or of arsenic as sold, mixed with various coloring matters—soot, indigo, and the like. The **general appearance** may give some clue to the mode of introducing the poison, the kind of food or drink used to conceal it, etc. Seeds of poisonous plants may be found; this is especially the case in India, where the seeds of **Datura** are frequently used for criminal purposes. Or the poisonous substance may have been administered in such quantity that a portion of it may at once be secured for an-

alysis, as not unfrequently happens in poisoning by arsenic. It is not enough to employ the naked eye in examining these suspected matters; the stomach, when opened, should be spread out on a piece of glass, or on a large plate, and its mucous membrane closely examined by a hand lens of some power; in this way characteristic crystalline forms, botanical peculiarities, and the like, may be made out.

Still, these investigations are merely introductory to the most important part of the research, which ought to be undertaken systematically, especially if the quantity of material to be operated on is small. Most frequently the matters to be examined are mixed, some soluble, some insoluble; but there may also be submitted for analysis portions of the pure substance. The object of the analysis is to obtain the substances which he has to examine chemically in as pure a condition as possible, so that there may be no doubt about the results of his testing; also, of course, to separate active substances from those that are inert, all being mixed together in the stomach and alimentary canal. Again, in dealing with such fluids as the blood, or the tissues of the body, their natural constituents must be got rid of before the foreign and poisonous body can be reached. There is this difficulty further to contend with: that some of the most poisonous of substances are of unstable composition and readily altered by chemical reagents; to this group belong many vegetable and most animal poisons. These, therefore, must be

treated differently from the more stable inorganic compounds. With an inorganic poison we may destroy all organic materials mixed with it, trusting to find the poison still recognizable after this process; not so with an organic substance: that must be separated by other than destructive means.

When the mixture submitted for examination consists of bodies, some of them perfectly soluble and some perfectly insoluble, **simple filtration** may suffice to secure their separation; but this is rarely the case, some colloidal material being ordinarily mixed with the crystalloid and the plan of separating them by **dialysis** not being altogether successful.

When the substances looked for are volatile, distillation may be employed to secure them in a state of purity; in this way prussic acid is separated; but in case of the poisonous alkaloids other means must be adopted.

I. In the separation of such an alkaloid as strychnin, for example, the suspected material is,

1. First of all acidulated by one of the weaker mineral or stronger vegetable acids, and the mixture.

2. Carefully heated over a water bath. After a time this mixture

3. Is to be filtered,

4. The filter well washed with boiling distilled water, and

5. The filtered fluid subjected to evaporation. When dry, the substance.

6. Is to be rubbed up with distilled water, *and again* filtered; this process to ~~be~~ repeated

until a tolerably pure product is obtained. This is next,

7. To be neutralized by acid sodium carbonate—and

8. The freed alkaloid taken up by rubbing or shaking it with chloroform or ether, and the whole set aside in a well-corked tall test tube. Finally.

9. The ether or chloroform containing the alkaloid is to be removed by a pipette, and allowed to evaporate spontaneously, when the alkaloid will probably be left behind in a state fit for testing. The process is a modification of that invented by Stas.

II. For the destruction of organic matter in the search for an inorganic poison, such as arsenic, a process introduced by Fresenius and Von Babo is often employed. Its essentials are as follows:

1. The organic matter is to be reduced to as fine shreds as possible, and

2. Mixed with about one eighth of its bulk of pure hydrochloric acid, and a sufficient quantity of distilled water. This is to be

3. Heated, and, as it boils,

4. From time to time crystals of potassium chlorate are added, until the solids are reduced to a straw-yellow fluid. This is

5. Next treated with acid sodium sulphite, until a distinct smell of sulphurous acid is given off; after which

6. Hydrogen sulphid is to be passed through the fluid (concentrated if necessary) for some hours, thus throwing down most metallic poisons in the form of sulphid. This precip-

itate is to be collected and further tested. Especial caution is advised not to mistake the reddish-brown precipitate caused by hydrogen sulphid, in an acid solution of a highly organic colored material (such as may be found in a human stomach, but without any poison), with an impure metallic sulphid which resembles it very strongly in color.

When exceedingly small quantities are dealt with, the microscope is of use, and the plan of subliming alkaloids and examining their crystals under the microscope, introduced by Guy, Helwig and Wormley, will be found very useful. The shape of crystalline poisons is a valuable means of determining their identity; arsenic and antimony may thus be readily distinguished from each other, as may some other well-known substances.

The spectroscope has not yet been much applied to toxicologic research, although it has been much employed to determine the existence of blood stains.

CHAPTER VI.

CLASSIFICATION OF POISONS.

THERE is nothing more difficult in toxicology than to give a satisfactory classification of poisons, insomuch that some have fallen back on the no-classification or natural history system, and grouped poisons as mineral, vegetable, and animal, according to their source. In despair of achieving anything better, a modification of an old and well-known

system is here followed, poisons being classed as **CORROSIVES, IRRITANTS (Simple and Specific) and NEUROTICS:** the last group is, however, further subdivided.

The group of **corrosives** should comprehend all poisons which by contact destroy the bodily textures, and so by chemical action alone occasion death.

These same substances, when diluted, may be incapable of destroying the tissues directly, but may do so by setting up inflammation; these, with certain others having like effects, would form the group of **simple irritants.** They kill by virtue of their secondary effects on the constitution. But some substances, like arsenic, are not only capable of inducing local inflammations, with their secondary effects, but are also possessed of certain specific and well-marked properties differing in each case. These are **specific irritants.**

Neurotics comprehend all poisons whose effects are referable to the nervous system—necessarily a most diverse group, which we are not yet in a position to minutely analyze. Some, however, act mainly on the **brain (opium),** some on the **spinal cord (strychnin),** some on **certain nerves** only **(curare),** or on the **vasomotor system of nerves (amyl nitrite).**

There was an old group of **septic** poisons. To this might still be referred certain noxious gases, such as hydrogen sulphid; or were it made to include all poisons acting directly on the blood, it would include the still more dangerous gas, carbon monoxid.

The following table exhibits these subdivisions, and some of the poisons contained in each:

CORROSIVES.	Strong Mineral Acids	Sulphuric.
		Nitric.
		Hydrochloric.
	Vegetable Acids.....	Oxalic.
	Organic Derivatives..	Carbolic Acid.
	Alkalies....	Strong Alkalies.
		Alkaline Carbonates.
SPECIFIC IRRITANTS.....		The above diluted.
		Lime.
		Zinc.
		Silver.
SIMPLE IRRITANTS.....		Arsenic.
		Mercury.
		Antimony.
		Phosphorus.
		Iodin.
NEUROTICS..		Opium.
		Prussic Acid.
		Chloroform.
		Belladonna.
		Aconite.
		Strychnin.
		Conium.
		Tobacco.
		Phenol.

CORROSIVE POISONS are characterized by these three things: 1. **Immediate action.** 2. ***Local* effects,** such as **destruction of tissue**

and staining; and in many cases by 3. Death from shock.

IRRITANT POISONS give rise to—

1. Pain in the stomach and bowels. 2. Faintness and sickness; and 3. Purging with straining. 4. The evacuations are often tinged with blood. 5. The pulse is feeble and irregular; and 6. The skin is cold.

Many of the substances of this class, from irritating the tissues with which they come in contact, produce a severe burning sensation in the mouth and esophagus, as well as in the stomach. The degree of local destructive action produced will of course vary in proportion to the amount of the vehicle with which the noxious agent may be diluted. Irritants cause death by inducing collapse or convulsions or by exciting severe inflammation; or, in some cases, after a variable internal, by leading to stricture of the esophagus. The diseases which most resemble the action of irritants are, malignant cholera, severe diarrhea, colic, cholera morbus, gastritis, enteritis, rupture of the stomach or intestines, and obstruction of the bowels, mechanical or otherwise.

NEUROTIC POISONS.—The symptoms ot certain diseases bear a resemblance to those caused by some of the poisons of the neurotic class. Thus, belladonna gives rise to delirium with special illusions or convulsions. Sometimes there is tetanus, as in strychnin poisoning; sometimes coma (opium and carbolic acid), or syncope (digitalis). Diseases of the

brain and spinal cord, likely to be confounded with the effect of these poisons, are often very insidious in their progress, and hence may suddenly give rise to suspicious symptoms. The history, mode of attack, etc., will generally negative any suspicion of poisoning.

The above facts show the necessity of extreme caution in diagnosing a poison from the symptoms exclusively.

I.—CORROSIVES.

CHAPTER VII.

THE CONCENTRATED MINERAL ACIDS.

THE first division of the Corrosives consists of the strong mineral acids. In this chapter we have to review the effects and properties of the acids commonly met with, which are Sulphuric Acid, Nitric Acid and Hydrochloric Acid.

SULPHURIC ACID (Oil of Vitriol).—This heavy, oily-looking liquid is met with in two forms, concentrated and diluted; and being extensively employed in commerce and manufactures is much more frequently used as a poison than the other mineral acids. Many infants and young children have been poisoned by it; occasionally also men, under the influence of drink. The acid is not unfrequently thrown over the person, either to disfigure the features or to destroy the clothes. The parts of the body with which it is brought into contact are stained at first of a white, and afterwards of a dark brown or black color. The smallest fatal dose of concentrated acid recorded, in the adult is **one dram**; but recovery has taken place after as much as two ounces. But it must be understood that the

acid proves fatal mainly by its power of corrosion, so that a small dose of the concentrated acid is more dangerous than is a much larger dose of it in the dilute form. The average period at which death occurs is from sixteen to twenty-four hours; but on the other hand, death may not occur for months, and may only follow the organic changes induced by cicatrization following the swallowing of the acid, or the malnutrition resulting from its destructive action on the coats of the stomach.

Death may arise from the action of sulphuric acid without that substance entering the stomach. It may act on the respiratory passages, causing closure of the glottis, or it may destroy the lining membrane of the air-tubes. This is most common in children. In this case death is much more rapid.

The signs of poisoning by oil of vitriol during life are chiefly these:—

(a) **Staining** of the lips and mouth—usually brown, but the mouth may be white at first. If a spoon or the neck of a bottle has been used in the administration of the poison, the mouth may escape.

(b) **Pain**—this comes on **immediately,** and extends from the mouth to the stomach; usually it is very severe.

(c) **Vomiting** shreds of mucus altered in color, and of coffee-ground-like matter, mainly blood more or less altered; the matters first vomited are strongly acid, discolor cloth, and act on limestone. Vomiting may be absent.

(d) **Great prostration.** Death usually takes place from shock or asphyxia within twenty-four hours.

The usual post-mortem appearances, if death has been speedy, are these:—

1. Softening and destruction of the lining membrane of the mouth, pharynx, and esophagus, sometimes with separation.

2. The stomach is perforated or softened, its contents black and tar like from altered blood, the blood in the vessels hard and black; it perforated, the edges of the opening are dark and ragged; often the organ is so soft that it cannot be moved without rupture. If the contents of the stomach have escaped, the surrounding organs may like itself be softened and blackened. N. B.—The softening may be partly post-mortem if the acid has not been neutralized during life.

3. If life has been slightly prolonged, there will be marks of inflammation in the bowels, peritoneum, and other parts not directly acted upon by the acid.

4. If the acid has entered the air-passages, similar marks of corrosion will be found there.

TESTS.—It is not within the province of these Memoranda to describe in full the processes by which poisons are to be detected, but the ordinary tests will be briefly described, it only to help the physician to treat the case more satisfactorily than he could do by merely guessing that an irritant or narcotic had been employed.

Concentrated sulphuric acid is usually a brownish-colored liquid, which chars or corrodes

wood or other organic matter brought into contact with it, and when mixed with water gives out heat. When diluted, its presence may thus be detected.

1. The liquid is known to be acid by its action on litmus paper.

2. Add to a portion of the suspected liquid a few drops of nitric or hydrochloric acid, and then a solution of barium chlorid; a white precipitate (barium sulphate) will fall if sulphuric acid be present. This test is extremely delicate; for although other acids yield a precipitate on the addition of barium chlorid, yet as such deposits are all soluble in hydrochloric acid, the previous addition of this acid will prevent their formation.

3. The precipitate should next be collected, dried, and reduced with charcoal by the blowpipe flame, or mixed with black flux and heated in a reduction tube, to the condition of barium sulphid. This, when treated with a drop of hydrochloric acid, gives off hydrogen sulphid, known by blackening paper dipped in lead acetate solution.

A very delicate test for diluted acid is veratrin. A fragment of this, in contact with a few drops of weak acid, if heated, will yield a beautiful purple color.

Cloth stained with this acid is usually either brown or black, the texture destroyed, and the stain has a great tendency to attract water. To examine a piece of cloth stained with this poison it is only necessary to boil it in distilled water, and then apply to the liquid the barium test as before.

TREATMENT.—**On no account use the stomach-pump;** the tissues are usually too much softened, and perforation might be the result.

Neutralize and give diluents freely.—Thus powdered chalk, whiting or baking soda may be given in milk or water. So too may ordinary calcined magnesia, or liquid magnesia; small quantities of ordinary washing soda in milk or water may be given if the patient can swallow it, but often it produces great pain; linseed tea, barley water, oatmeal gruel, diluted starch—all are useful.

NITRIC ACID (Aqua fortis).—This substance is sometimes given or taken in poisonous doses, but not so often as oil of vitriol. It is found in commerce in a concentrated and in a diluted state. Cases of death from its use are rare. Two drams is the smallest quantity which has destroyed life; but less than this would probably prove fatal, if it specially affected the windpipe. Death has occurred from it in one hour and three quarters; the average would be within twenty-four hours.

SYMPTOMS.—The symptoms of poisoning by nitric acid do not materially differ from those of poisoning by oil of vitriol, save in respect of the stains produced. These are at first **white,** but this lasts only a very short time; afterwards becoming **yellow** or **orange,** and finally **brownish-red.** They are very persistent. So too the vomited matters are yellow or brown.

The vapor of nitric acid has sometimes proved fatal. This has occurred in more than one instance where a vessel containing a large quantity has been broken and the gas inhaled. The fumes produced by the action of nitric acid on various organic substances, such for instance as are given off in the manufacture of gun-cotton, are likewise dangerous.

APPEARANCES AFTER DEATH.—The most characteristic are the discoloration already mentioned, together with erosion and softening of the mucous membrane of the digestive tract, but the stomach is rarely perforated, though softened. The appearance of the stomach may be altered as regards color—by the action of the acid on itself (yellow); by the action of the acid on the blood (black), and by the action of the acid on the bile (green or brown).

TREATMENT.—**On no account use the stomach-pump.** If the patient can swallow, give lime-water, or chalk in water, magnesia, boiled starch, linseed tea, or any stimulant at hand. The use of alkalies must depend on the patient's feelings.

TESTS.—Concentrated nitric acid may be known by its orange-colored irritating fumes, and by its action on copper, tin, or mercury.

1. When poured on copper filings, effervescence takes place, a red acrid vapor is given off, and a blue liquid remains (solution of copper nitrate).

2. In a diluted state it is detected by its acid reaction; by no precipitate being obtained by

barium chlorid or silver nitrate, proving the absence of sulphuric and hydrochloric acids; further, by neutralizing the liquid with potassa, evaporating it, and then procuring crystals of potassium nitrate in the form of lengthened fluted prisms, which are permanent in the air. These crystals may be powdered and moistened with strong sulphuric acid, when a colorless acid vapor (nitric acid) will be evolved, which if directed through a solution of sulphate of iron will turn the fluid black or brown. Or the powdered crystals may be mixed with an equal bulk of fine copper filings, moistened with water, and treated with a few drops of sulphuric acid, when ruddy acid fumes will be given off.

3. Other tests for nitric acid are: its action on morphin, which it turns red; its action on green iron sulphate, which it blackens; a trace of it along with sulphuric acid gives with narcotin a blood red color, and, finally, along with hydrochloric acid, it dissolves gold.

HYDROCHLORIC ACID (Muriatic Acid, Spirit of Salt).—Though much used in the arts poisoning by hydrochloric acid is rare. In May, 1859, a woman sixty-three years old was admitted into King's College Hospital within three quarters of an hour of swallowing half an ounce of the strong acid. The mucous membrane of the mouth was white and softened. She had burning pain in the throat and stomach, vomiting of brown shreddy matters, and great prostration. Death occurred in eighteen hours, from the corrosive action of the poison.

This is the smallest dose which has been known to prove fatal.

TESTS.—The concentrated hydrochloric acid of commerce is of a yellowish color; it is colorless when pure; it fumes in the air when strong, and produces dense white fumes with the vapor of ammonia.

1. It may be identified by boiling with manganese dioxid, chlorin being given off. This gas is known by its odor, its yellowish-green color, its bleaching properties, and its power of setting free iodin from potassium iodid. Thus it blues a paper dipped in solution of starch and potassium iodid.

When diluted, hydrochloric acid is detected by means of silver nitrate, which causes a dense white precipitate (silver chlorid). The chlorid is distinguished from other salts of silver by (a) its insolubility in nitric acid, and in caustic potassa; (b) by its being soluble in ammonia; and (c) by its melting and forming a horny mass when dried and heated.

MIXED ACIDS.—These acids being used for commercial purposes when mixed—**the nitro-muriatic** (aqua regia) to dissolve gold, and the **nitro-sulphuric** sometimes to dissolve silver—are sometimes employed as poisons. **Sulphate of indigo,** which consists of a solution of indigo in strong sulphuric acid, has also proved fatal in cases in which it has been accidentally taken.

RECAPITULATION.—The symptoms produced by the mineral acids are much the same *in all cases.* There is a violent burning pain

in the mouth, gullet and stomach, commencing immediately. The burning is followed by retching and vomiting of a dark-colored liquid with shreds of mucus, and portions of the mucous membrane of the esophagus or stomach. The inside of the mouth is shrivelled and more or less corroded, unless the agent has been given in a spoon, drunk out of a bottle, or otherwise passed over the tongue to the back of the fauces. The outside of the lips and mouth will otherwise probably present the stains characteristic of the acid used. There is great thirst, difficulty of swallowing, and impeded respiration, which last may arise from pain in the abdomen. The bowels are confined; the urine scanty or suppressed. Next succeeds great exhaustion, the pulse becomes quick and feeble, and the skin gets cold and clammy. The countenance is anxious and expressive of great suffering, death speedily occurs, the intellectual faculties remaining clear to the last.

These acids may prove fatal without entering the stomach by causing asphyxia, the glottis becoming closed by swelling of the fauces, or of the mucous membrane of the larynx. They have sometimes been administered by the vagina, rectum, etc., and been poured into the ear during sleep.

Where recovery takes place from the immediate effects of the strong acids there is always fear of death resulting at the end of one or two years from stricture of the esophagus, and even at an earlier period, unless proper treatment is adopted. Occasionally one of the

secondary effects of poisoning by these acids has been profuse salivation.

The **post-mortem appearances** are the following: The body may have a healthy appearance. Usually there are stains about the mouth, fingers, and wherever the cuticle has been reached by the acid. The inner surface of the mouth, fauces, and esophagus is usually white and corroded at first, but dark-brown and shrivelled, or otherwise discolored after a time, the mucous coat being easily detached. The epiglottis and glottis are usually swollen. The gullet resembles the mouth in some respects. The outer surface of the stomach and intestines is very vascular, that of the former being sometimes corroded and occasionally perforated. The stomach is sometimes contracted, sometimes distended with gas, and contains a thick dark-brown fluid; its inner surface has sometimes a charred, blackened appearance, the mucous membrane between the rugæ being of a scarlet hue. The pylorus is mostly contracted; while the inner coat of the duodenum and small intestines presents a similar appearance, in a less degree, to that of the stomach, if the patient has lived long enough. When perforation occurs it usually takes place posteriorly if the patient, or after death the body, has been lying on its back, and the edges of the rent are softened. The escaped matters may have acted on the adjacent viscera.

According to Casper, after poisoning by sulphuric acid the bodies resist putrefaction for *some time. It* may be the same with the oth

mineral acids, and the action is doubtless due to the fact that microörganisms do not develop readily in acid substances.

TREATMENT.—**The first remedy at hand is the best. Baking soda** or **calcined magnesia,** or **white magnesia,** should be immediately given, mixed in milk or any mucilaginous fluid; the doses being continued at short intervals, until it may be inferred that the acid is neutralized. In the absence of these remedies substitutes may be found in chalk, whiting, soap and water. Oleaginous and mucilaginous fluids, as olive oil, linseed tea, barley water, milk, gruel, etc., may be freely given, either alone, or as the vehicles of the antidote. **The success of the treatment will depend upon the promptitude with which it is adopted.**

The stomach-pump should not be employed; the disorganized and softened state of the gullet and stomach rendering them excessively liable to perforation.

Should the larynx be affected and the breathing impeded, **tracheotomy** must be at once had recourse to.

After a sufficiency of the antidote has been given, the use of mucilaginous diluents must be continued for some time, and the subsequent treatment will be that for gastroenteritis. Great benefit will be derived from the use of oily enemata.

The external parts which have been injured by the acid should be well bathed with soap and water, and treated like burns.

CHAPTER VIII.

THE CORROSIVE VEGETABLE ACIDS.

OXALIC ACID (so-called Acid of Sugar).—This is one of the most important poisons with which we have to deal. From its cheapness and well-known properties it is frequently made use of in cases of suicide; while from its resemblance to Epsom salt it has on several occasions been taken in mistake for that medicine. The fatal dose of this poison is, comparatively speaking, large, usually not less than half an ounce; one dram killed a boy aged sixteen, in eight hours. It proves rapidly fatal. Taylor relates the case of a woman, aged twenty-eight, who was found dead in one hour after swallowing three drams of the crystallized acid. Christison mentions an instance in which one ounce destroyed life in ten minutes, and another case where the same quantity killed a girl in thirty minutes. One example has been recorded where a fatal result ensued probably within three minutes of the acid being swallowed.

The poisonous properties of the **acid potassium oxalate (salt of sorrel, essential salt of lemons)** are due to the oxalic acid it contains. This salt, which exists in the leaves of the sorrel, species of **Oxalis,** is used to bleach straw, and remove ink-stains. It is very cheap; is almost as powerful as oxalic acid itself, and gives rise to the same kind of symptoms; it

has been taken for the purpose of suicide, as well as in mistake for cream of tartar.

SYMPTOMS.—The effects of poisoning by oxalic acid are peculiar. When the dose is large (half an ounce or more) and the solution concentrated, it proves very rapidly fatal, as above mentioned. It produces:—

A hot burning sensation in the act of swallowing; severe burning pain in the stomach, and in most instances immediate vomiting.

The vomited matters are strongly acid, of a dark-brown or black color, and consist of the contents of the stomach with altered mucus and blood. In some cases no vomiting occurs. The remaining symptoms are: Sense of constriction about the throat, or suffocation; lividity of the countenance; great pain and prostration of strength; feeble pulse, cold clammy perspirations; and convulsions, which speedily terminate in death.

When a large dose has been taken, death takes place from utter collapse. When a smaller quantity has been taken, or the poison has been much diluted, its corrosive properties are weakened and destroyed, but the nervous symptoms, as cramps and numbness, may be well marked.

In cases of recovery the mouth may remain sore for some time, the tongue swollen, the abdomen tender, the stomach very irritable, and there may be troublesome diarrhea. In two instances there has been loss of voice for several days, owing to the action of the poison on the nervous system. Twitching of the

muscles of the face and extremities, as well as numbness, have also been observed.

POST-MORTEM APPEARANCES.—The mucous membrane of the fauces, esophagus and stomach is generally **white,** and **soft** or **brittle,** but often colored with the brown mucous matter discharged. The stomach often contains a black fluid, like coffee-grounds, consisting principally of altered blood; and its submucous coats are vascular and dark-colored. The stomach, though seldom perforated, may yet be so softened as to be with difficulty removed entire, and sometimes this is not possible. This softening may be partly due to the post-mortem action of the poison; but its effects during life in softening and blanching the mucous membrane, are sufficiently marked. Occasionally the stomach is **black** and gangrenous looking. If death has occurred quickly, the small intestines are seldom much affected; but where the symptoms have been protracted, there are usually signs of congestion and inflammation.

TREATMENT.—**Never use the stomach-pump.** Chalk, whiting, or magnesia, suspended in water, or in some demulcent fluid, must be administered **immediately;** and, if necessary, vomiting should be excited by tickling the fauces, or administering emetics; but the use of much fluid containing no antidote (**which** is **lime** in any shape) is to be avoided, as tending to favor absorption of the poison. The antidote, to be effective, must be given as soon *as possible;* the plaster of the apartment, or

any form of mortar, may be used in the absence of the remedies just mentioned. Alkalies (soda, potash or their carbonates) are not only useless, but they form salts with oxalic acid, which are as injurious as the acid itself. When there are symptoms of collapse, stimulants are to be freely employed, but they should be given per rectum.

TESTS.—Crystals of oxalic acid are met with as four-sided prisms, colorless, without odor, permanent in the air and very acid; this last character distinguishing them from crystals of magnesium sulphate and zinc sulphate. The crystals, when heated, melt, and are dissipated without being charred, and leave no residue. This character is important as a means of distinguishing oxalic acid from other similar crystals. They are soluble in from eight to twelve parts of cold water. The acid may be thus recognized in solution:

1. **Silver nitrate** throws down, with oxalic acid, an abundant white precipitate (silver oxalate), which is soluble in nitric acid. This, when dried and heated on platinum foil, detonates, and is dissipated in a white vapor.

2. **Calcium sulphate** causes a white precipitate with oxalic acid (calcium oxalate), which is soluble in nitric or hydrochloric acid, but not in any vegetable acid.

The solution containing the acid should be concentrated before testing, if it is not present in considerable quantity.

Lime water and soluble calcium salts throw down precipitates with oxalic acid; but as these are liable to be mistaken for a precipi-

tate with sulphuric acid, it is better to use calcium sulphate, which is slightly soluble, as test agent.

A good deal of the test solution must be used, and the precipitate takes time to settle.

3. **Copper Sulphate** gives a faint bluish precipitate with oxalic acid (oxalate of copper), which is not redissolved by a few drops of hydrochloric acid.

N. B.—These tests will not act if the solution contains excess of strong acids, in which case the liquid must be evaporated to crystallization, and the crystals washed and redissolved in water.

SEPARATION FROM ORGANIC MIXTURES.—The test for oxalic acid should never be applied without previously separating it from all organic matter. This is best done by first of all—

1. Digesting with water and filtering to get rid of solid matters.

2. Acidulating the suspected fluid with acetic acid; and then

3. Adding lead acetate. This combines with the oxalic acid to form a white insoluble salt, which may ordinarily be removed by renewed filtration or subsidence.

4. This filtrate, after being well washed, is

5. To be diffused in water, and into this a current of sulphuretted hydrogen gas is to be passed for some considerable time. This will throw down the lead as sulphid, leaving the oxalic acid in the fluid; any organic matter will also be carried down.

6. *Filtration* will separate the solids from

the liquid containing the acid, which may now be evaporated until crystals are formed, and tested in the usual way.

ACETIC ACID.—Although this acid, in its concentrated state, is highly corrosive, yet it is very seldom brought under the notice of toxicologists.

In the case of a young woman reported by Orfila, death quickly occurred after several attacks of convulsions. At the subsequent post-mortem examination, the tongue and esophagus were of a dirty brown color, the latter being intersected by a fine network of capillary vessels; and the interior of the stomach was interspersed with black elevations caused by the presence of coagulated blood in the submucous areolar tissue. The mucous membrane was entire.

As regards the **treatment,** it is only necessary to administer draughts containing magnesia or its carbonate, followed by mucilaginous or demulcent drinks.

TARTARIC ACID, though not a corrosive, may be here placed along with the other vegetable acids. Tartaric acid has destroyed life in at least one instance in this country; an ounce having been given in mistake for an aperient salt and swallowed at once. The patient complained of intense pain in the throat and stomach, as if he had swallowed oil of vitriol, or was on fire. Soda and magnesia were administered without avail; and after death, at the end of nine days' suffering, the stomach and intestines were found much inflamed.

CHAPTER IX.

CORROSIVE ORGANIC DERIVATIVES: CREASOTE AND CARBOLIC ACID (PHENOL).

BOTH creasote and carbolic acid possess poisonous properties, but as the use of the latter is much more common than is that of the other, for which it is commonly substituted, a description of its effects will here suffice.

Carbolic acid is a product of coal-tar, and is found in the pure state as crystals, and impure as a liquid. It has a highly characteristic odor, and hence is not likely to be used for homicidal purposes, except in the case of children or people who are intoxicated; but inasmuch as it is now so largely used as an antiseptic, many accidents have happened from its being swallowed by mistake, in spite of its taste and smell.

Though placed here among corrosives, carbolic acid has a two-fold action—one local, of a corrosive nature; another, from its effects on the nervous system; and it is this last which seems most frequently to prove fatal; neyertheless, it may be most conveniently discussed in the present connection.

SYMPTOMS.—When swallowed, carbolic acid gives rise at once to pain in the stomach and whitening of the lips and mouth. Vomiting does not appear to be a common symptom, and pain is not always noted. But in a few minutes there come on coma, stertorous breathing,

and **the pupils are contracted** to a very marked degree. Death usually follows within a period of from a few minutes to eight or ten hours or more, but most frequently within an hour or two. If urine is passed or drawn off it is usually dark colored.

APPEARANCES AFTER DEATH.—The mouth, throat, gullet, and stomach are whitened and sodden, and the mucous membrane readily removable. Between the folds of the stomach reddening is observed. The vessels of the brain are congested if the patient has lived for any length of time, and its fluids, together with the blood in other parts of the body, may give off the odor of carbolic acid. This same odor is also appreciable in the stomach, in the intestines, and frequently in other organs, as the kidneys.

The usual fatal dose is about an ounce of the impure acid, but smaller quantities have proved fatal.

TREATMENT.—Death, in poisoning by carbolic acid, may be so rapid that little time is left for treatment. The object of this should be prompt neutralization of the poison. Oleaginous substances, which will dissolve the acid and so dilute it, which cannot be absorbed in the stomach, have been suggested, together with emetics, to get rid of them; if allowed to be absorbed they will only aggravate the evil. There is not the same objection to the stomach-pump or stomach-tube here as there is in the case of some other corrosive poisons, as the softening is superficial; never-

theless, it must be used with caution. Soluble sulphates (*e. g.* sodium sulphate) convert the carbolic acid into sodium phenol-sulphonate. The best antidote to phenol is alcohol. In cases of external injury the strongest alcohol may be used, but when the poison has been swallowed whiskey is more suitable. It should be used promptly and liberally.

TESTS.—Of all the tests for carbolic acid its odor is the most characteristic. Where it is present in any quantity, heating, with or without a small quantity of sulphuric acid, will set it free, and it may be collected by a retort in the usual way. Bromin water throws down a whitish-yellow precipitate.

In case of poison by carbolic acid, the symptoms may not differ greatly from those of poisoning by opium; do not neglect, therefore, to note the appearance of the mouth, and the smell of the breath.

LYSOL.—Lysol is a mixture of cresols, rendered soluble in water by the addition of sodium hydroxid. It is much used as an antiseptic in obstetric procedure. When swallowed in poisonous doses, it causes local corrosion analogous to, but usually not so severe as, phenol, cyanosis, edema of the lung, immobility of the pupils and general collapse. Vomiting may occur early or late in the case. Death sometimes occurs after the symptoms have abated.

TREATMENT.—Experience in lysol poisoning shows that prompt use of the stomach-pump *was followed* by the recovery of all the pa-

tients, while the neglect of this measure was almost invariably fatal. In the eighteen cases collected, poisoning occurred in thirteen from internal and in five from external use of the agent. Nine of the patients died. The largest dose from which the patient recovered was 60 grams (925 grains), taken by a woman, and 25 grams (385 grains), by a four-year-old child. The smallest dose that proved fatal was a teaspoonful, about 4 to 5 gm. (60 to 75 grains), of pure lysol, in children from five to eight years old.

CHAPTER X.

THE CAUSTIC ALKALIES AND CARBONATES.

THE second great division of the class Corrosives has now to be considered. It contains the caustic alkalies, and some of their salts. Poisoning by any of these agents is rare.

POTASH (Potassium hydroxid).—This substance, in its caustic state, as found in commerce is in the form of gray-colored cakes. It has an acrid taste, is soapy to the touch, and very deliquescent. Moulded in cylinders it is often employed as a caustic. In solution it is strongly alkaline, and imparts a brown stain to black cloth.

Potassium Carbonate or **Carbonate of Potash** (pearl-ash) is generally sold in a granular condition, white, inodorous, and strongly alkaline; it is soluble in water, but not in alcohol.

CAUSTIC SODA (Sodium hydroxid).—This agent resembles potash in its general properties. The **Sodium Carbonate** or **Carbonate of Sodium** (washing crystal) bears a similar resemblance to the potassium carbonate, except that it crystallizes easily, and does not deliquesce, but effloresces on exposure to the air.

AMMONIA (Ammonium hydroxid).—When pure, ammonia is a colorless, pungent gas; but it is commonly met with dissolved in water. Its vapor is poisonous, and may prove fatal by producing inflammation of the larynx and trachea, and even of the lungs. An instance is recorded by Dr. Taylor, as occurring in the practice of Mr. Hilton, in which liquor ammoniæ, given by mistake, caused corrosion of the throat and gullet, and obstruction of the bronchial tubes by false membrane. The esophagus was completely dissolved at its junction with the stomach, and there was an aperture in the anterior wall of that organ, such as might have been caused by oil of vitriol. The most characteristic feature of ammonia poisoning, besides the fact that it may be detected by means of a glass rod dipped in hydrochloric acid, and held near the mouth, is the frequency with which the air-passages are affected.

AMMONIUM CARBONATE or **CARBONATE OF AMMONIA** (smelling salts), has been used as a poison. It may be distinguished from other salts by its being alkaline, by its entire volatility, and by its pungent odor.

Symptoms.—The chief symptoms occasioned

by the foregoing poisons are an acrid, burning taste coming on during swallowing, with a sensation of excoriation and burning extending along the mouth and throat, to the stomach. There soon ensue exquisite pain in the epigastrium, and tenderness on pressure. Frequently there is cough, hoarseness, dyspnea, as well as vomiting of altered mucus mixed with blood and detached portions of the mucous membrane. The tongue, mouth, and fauces become swollen, soft, and flabby, and deglutition is difficult. The surface of the body becomes cold and moist, the pulse small and feeble, and there is great pain over the abdomen, with diarrhea. Death took place, in the case of a boy, in three hours from the time of swallowing a strong solution of potassium carbonate. Ammonia, by its effect on the air passages, has proved fatal in four minutes. When recovery from the immediate effects of the poison has taken place, death has subsequently ensued from stricture of the esophagus, producing starvation. By the proper use of bougies, life may occasionally be prolonged for many months or even for years. In some instances however it is almost impossible to effect dilatation, owing to the whole of the gullet becoming thickened and contracted, so that the opening into the stomach will hardly admit of crow-quill. The pylorus may also be contracted in like manner.

POST-MORTEM APPEARANCES.—The mucous membrane of the mouth and gullet is softened and inflamed, and portions of it detached. The coats of the stomach and intestines are in-

flamed, stained of a dark color, and sometimes ulcerated. When death has resulted from ammonia, signs of inflammation are usually found in the larynx and bronchial tubes. The other caustic alkalies may also destroy life by producing inflammation of the glottis, which consequently may be found thus occluded after death.

TREATMENT.—**Never use the stomach-pump.** The object must be to neutralize the poison, which may be effected by a weak acid. Vinegar and water is perhaps the best antidote, and is most readily procurable: its administration may be followed up by the free use of acidulated demulcent drinks, lime or lemon-juice, orange-juice, etc. This use of oil has been recommended, on the principle that it converts the alkali into a soap. But that its efficacy is doubtful has been in some measure shown by the death of two young children from swallowing a mixture of ammonia and oil. In one of these cases nearly two ounces of linimentum ammoniæ (made of one part of liquor ammoniæ to two of olive oil), were poured down an infant's throat by a child five years old. If, however, the oil were given in much greater abundance, the result would probably be different. At all events, its administration should not be neglected.

TESTS.—The specific character of these substances is their strongly marked alkalinity, ammonia possessing, over and above, that of volatility.

KEROSENE AND GASOLIN.—Cases of severe intoxication with insensibility, sometimes followed by mania, due to the drinking of gasolin or inhalation of its vapors are not uncommon in large cities. Two cases of gasolin poisoning occurred among sailors in the Santiago blockading fleet in 1898. They obtained the gasolin from one of the launches. One man died and the other became insane.

SYMPTOMS OF KEROSENE POISONING.—Vomiting followed by signs of collapse, chiefly circulatory. Odor of the breath markedly that of kerosene.

TREATMENT.—The stomach should be washed out with warm water. Other treatment is mainly symptomatic. The patient should be kept under observation for at least twelve hours and the possibility of a sudden fatal issue never lost sight of.

II.—SIMPLE IRRITANTS.

CHAPTER XI.

SALTS OF POTASSIUM. LIME.

POTASSIUM NITRATE, NITRATE OF POTASH (Nitre, Saltpeter, Sal prunelle), is more dangerous in large doses than is commonly supposed. It has sometimes been given in mistake for other salts as a purgative, and in one instance caused death in about two hours. In another such instance, referred to by Orfila, an ounce proved fatal in three hours. This may be considered as the usual fatal dose, the time required being from two to three hours. It produces symptoms of irritation of the alimentary canal, vomiting and diarrhea. There is generally also severe pain at the pit of the stomach, trembling of the limbs, scanty urine, and collapse. Marks of violent inflammation are found after death in the stomach and along the intestinal canal.

POTASSIUM SULPHATE, SULPHATE OF POTASH has proved fatal when taken in a large dose. It has caused death in two or three cases when purposely administered to procure abortion. Taylor quotes an instance of a lady, a week after delivery, being directed by her medical attendant to take ten drams

of this salt, in divided doses, as a laxative. After the first dose she was seized with severe pain in the stomach, with vomiting, etc., the symptoms increasing after each dose, and proving fatal in two hours. At the post-mortem examination the mucous membrane of the stomach and intestines was seen to be pale in some parts, but reddened in others, and the stomach contained a quantity of reddish-colored liquid. This, on being analyzed, was found to contain no other irritant but the above salt.

POTASSIUM BITARTRATE, ACID POTASSIUM TARTRATE (Cream of Tartar, Argols).—This salt has caused death in one case at least, in which about an ounce and a half was taken. The symptoms were those of an irritant poison, with what seemed paralysis of the lower extremities. Death occurred within forty-eight hours.

Liver of Sulphur.—An impure potassium sulphid has also caused death as an irritant poison.

TREATMENT.—As no antidotes are known to these salts, the treatment must consist in producing vomiting as speedily as possible by means of emetics, or the stomach-pump may be used. Demulcent drinks should be freely given, together with soothing applications to the bowels. Ice may be given in any quantity.

LIME acts as an irritant poison, though a feeble one, when taken into the stomach, or applied to a vital part. One fatal instance is reported where a boy swallowed some lime in

an apple-pie. He died in nine days, after suffering from a burning pain in the abdomen, great thirst, and obstinate constipation. Unslaked or imperfectly slackened lime may also prove fatal by being inhaled, and so giving rise to inflammation of the larynx and trachea. A man was ordered to drink lime water. He took a piece of burnt limestone, put it in water, stirred it about, and drank the thick fluid. He died in a few hours.

CHAPTER XII.

ZINC—SILVER—TIN—BISMUTH—CHROMIUM—IRON.

Two preparations of zinc must be noticed:

ZINC SULPHATE (White Vitriol).—This is a mild irritant, resembling in its appearance Epson salt and oxalic acid. It is very useful as an emetic in scruple or half drachm doses, dissolved in any thin fluid.

In one case an ounce was accidentally taken. Great pain in the stomach, vomiting, and prostration, soon set in. Subsequently there was gastritis, and recovery only occurred after a prolonged convalescence.

TREATMENT.—Vomiting is to be encouraged by milk or albuminous fluids. As antidotes, remedies containing tannin (strong tea, decoction of oak bark, or tincture of Peruvian bark) are to be given.

ZINC CHLORID.—A solution of this is a dangerous irritant, or if sufficiently strong, a *corrosive* poison.

SYMPTOMS.—A burning sensation in the mouth and throat is immediately produced; often with signs of local corrosion, though these may be absent. This is followed by nausea, vomiting, and signs of collapse, purging, sometimes with cramps and convulsions. Death has occurred in less than two hours.

POST-MORTEM APPEARANCES.—The mucous membrane of the throat and stomach has been found corrugated, hard and leathery. In the case of a sailor who died from about half a pint of Burnett's solution, the cerebral vessels were engorged, and the lungs were congested. The mucous coat of the stomach was of a purple red, and partially corroded, while the pyloric orifice looked as if caustic had been applied to it. There were patches of congestion in different parts of the small intestines.

TREATMENT.—Albuminous drinks, such as milk and white of egg, followed by some preparation of tannin, should be freely given.

TESTS.—Zinc is distinguished from all other substances by giving a white precipitate with hydrogen sulphid. Note that the solution containing the poison must be neutralized, so as not to be too acid, or no precipitate will be formed. Zinc also gives white precipitates with potassium ferrocyanid and ammonium hydroxid.

SILVER NITRATE (Lunar Caustic).—This is a powerful irritant, and has proved fatal in at least two instances. The antidote is common salt, which may be given freely and at once, followed by emetics.

TIN.—Tin chlorids are employed in dyeing, color-making, etc., which may lead to their being used as poisons, or being taken accidentally. Death from their use is rare. They are decomposed by magnesia, which should therefore be freely administered, followed by albuminous and mucilaginous drinks.

BISMUTH.—The commercial subnitrate (magistery of bismuth) has caused death in nine days, after a dose of two drams. The symptoms were those of a strong irritant, but in all probability were caused by some impurity in the substance. **Arsenic** is frequently present. As no antidote is known, vomiting must be promoted and emollient drinks freely given.

CHROMIUM.—Potassium bichromate is extensively used in the arts, and has caused death in more than one instance. Emetics and magnesia or chalk must be the remedies employed.

It is well to know that this substance is apt to produce troublesome sores on the hands of those engaged in its manufacture. Some slight abrasion begins the lesion, which does not heal, but forms on its surface a tough slough, which separating leaves a foul and most intractable ulcer, with hard edges, behind it.

IRON SULPHATE (Green Vitriol, Copperas).—Although not a powerful irritant, sulphate of iron has proved fatal when taken in a large dose. It is sometimes given to procure abortion. **Ferric chlorid** has also pro-

duced alarming symptoms, after being taken for the same purpose.

Magnesia and diluents, freely administered, must constitute the treatment.

MAGNESIUM SULPHATE.—This aperient, commonly called Epsom salt, has caused death in several cases, when large doses were given. It acts as severe irritant, but without producing corrosion. There is no specific antidote. Symptomatic treatment is all that can be advised.

CHAPTER XIII.

SIMPLE VEGETABLE AND ANIMAL IRRITANTS.

THIS division of the class of simple irritants is an important one, on account of the substances composing it consisting in considerable part of ordinary remedies or drugs, which, given in over-doses, may produce symptoms of poisoning. They chiefly give rise to vomiting and purging.

VEGETABLE IRRITANTS.

The most important are **aloes, colocynth, jalap, gamboge, scammony, elaterium, croton oil, castor-oil seeds,** various species of **arum, euphorbium, bryony, mezereon, physic nut,** and others less commonly known. Dr. Taylor says that aloes and colocynth are the basis of **Morrison's pills,** which in many instances have induced fatal purging. In **Halloway's pills** aloes is the chief ingredient. A favorite remedy with nurses for promoting the catamenia is

hierapicra, a brown powder consisting of four parts of aloes to one of canella bark. This may give rise to dangerous symptoms.

The **symptoms** induced by these substances are those of irritation of the intestinal canal, severe pain, vomiting, diarrhea, tenesmus, etc.; followed by collapse, cold sweats, and occasionally convulsions.

The **treatment** must be directed to the removal of the injurious substance by emetics and diluents, unless spontaneous vomiting has freely taken place, when it need merely be encouraged by the use of diluents. If the irritant has passed out of the stomach into the intestines it must be carried off by purgatives such as castor oil. The inflammatory symptoms should be cautiously combated, on account of the great prostration usually caused by these poisons. Opiates, emollient enemata, and fomentations of the abdomen, will subsequently be found useful.

SIMPLE ANIMAL IRRITANTS.

The substances which require consideration under this head, though few, are important.

Poisonous Fish.—Several kinds of fish are constantly poisonous, while some only act injuriously on particular constitutions. The chief effects are sickness and vomiting, irritation of the eyes, depression, and severe urticaria or nettle-rash. In this country the different varieties of shell-fish are those most frequently injurious, especially cockles, mussels, crabs and such-like.

Poisonous Meat.—The flesh of animals which have died of disease has produced serious symptoms when eaten, and has even destroyed life. Several substances, as sausage, cheese, bacon, etc., also become poisonous from putrefaction.

The case of the poisonous action of meat and some other forms of food has attracted much attention of late years, especially in connection with the modern bacillar pathology. It will be sufficient to state that a portion of the condition on which the poisonous action depends, is due to the production of bodies, analogous to the vegetable alkaloids. These bodies are called "ptomains." They are products of decay; they are difficult to study, and only a few are definitely known. Their production is connected with the development of microörganisms, probably as the excreta of these organisms. In some cases the pathological processes formerly ascribed to the microbes, are now believed to be due to ptomains. Many of these are known. It has been shown that different results may be obtained according as air is excluded or admitted to the decomposing mass, and also that the length of time during which the decay has been going on, makes considerable difference in the product. This in part explains why stale food, that is, food which has just begun to decay, is often more virulent than that which is in an advanced state of decomposition. The ptomains first formed are destroyed early in the decay, and their place taken by less active but

more disagreeable agents. The study of the ptomains is especially interesting in their connection with the alkaloid poisons, which some of them closely resemble in certain of their properties. Their presence in a putrefying human body may also materially interfere with the discovery of the alkaloidal poison which has been the cause of death.

Among the articles of food especially liable to give rise to poisonous action are articles made from eggs and milk. The poisonous action of cream-puffs, ice cream and cheese is in most cases probably due to ptomains. Sausage poison, and similar meat poisonings, are analogous cases, always bearing in mind, however, that in the case of meat, especially when raw, the possibility of parasitic animals being the cause of the symptoms must not be forgotten. Thus, in the case of sausage poisoning, trichinæ are often the cause.

No special treatment is known for these cases of poisonous food. They are generally attended by much gastro-enteric irritation, but if the vomiting is not free it must be promoted by gentle emetics. The stomach-pump and a subsequent rinsing out with water will be advantageous. Some of the antiseptics, such as thymol, salol, naphthalene, may be of advantage. Great irritation must be controlled by sedatives, and supportive measures may be required when there is great prostration.

CHAPTER XIV.

IRRITANT GASES.

THE chief acrid poisoning gases are **chlorin, sulphurous acid, nitric oxid** and **hydrochloric acid.** When diluted, they admit of being inhaled; not so when pure.

CHLORIN.—This gas has a greenish-yellow color, and a powerful suffocating odor. It is used to fumigate buildings, being a valuable disinfectant. Chlorin is employed by the calico-printer and paper-maker for its bleaching properties. Any attempt to inspire chlorin in its concentrated state would at once prove fatal by closing the glottis and causing asphyxia. Even when diluted it excites excessive irritation of the air-passages, cough, difficulty of breathing and inflammation.

In poisoning by chlorin, the inhalation of a small quantity of hydrogen sulphid appeared to afford relief in a case reported by Christison; but with that, or any other of the irritant gases, our treatment must chiefly consist in the instant removal of the sufferer to pure air. Then the cautious inhalation of ammonia, sulphuric ether, or the vapor of warm water, will be useful.

Several chlorin oxids are known. They are irritating and poisonous gases.

SULPHUROUS ACID is one of the products formed by the combustion of most samples of ordinary coal. It possesses bleaching and antiseptic properties, and is very irritating.

NITRIC OXID produces inflammation of the air-passages. It has proved fatal in several instances.

HYDROCHLORIC ACID GAS, even when diluted, produces great irritation of the air-passages.

FORMALDEHYDE.—This antiseptic and disinfectant, commonly sold in 40 per cent. solution as "formalin," is an acrid vapor and a marked local irritant. In a case recently (1905) reported by Dr. Levison, of Toledo, O., a man took an amount, estimated at 2 fluid ounces, of formalin, and was promptly seized with violent pain in the stomach, profuse lachrymation, noisy labored respiration, 30 per minute, and greatly increased mucus secretion. The pulse at first strong, rate 112, became weak and finally imperceptible. Cyanosis was marked. Pupils were dilated before death. The patient died about twenty-five minutes after taking the poison. The odor was marked on the breath, and in the stomach at the post-mortem. The esophagus and stomach were dark and leathery. Apormorphin (3 hypodermic injections, 1-10 grain each). Also strychnin and adrenalin were inefficacious. A spasm of the esophagus prevented washing out of the stomach, which would probably be the best treatment. Raw eggs might be of service. An alkaline solution of hydrogen dioxid destroys formaldehyde, but is of little practical value as it cannot be freely given. The odor will be the *best diagnostic* point.

III.—SPECIFIC IRRITANT POISONS.

By Specific Irritant Poisons we mean those which, taken internally:

(*a*) Produce **local inflammation** or **irritation,** which is indicated by certain constitutional symptoms; but over and above these, which may be the result of ordinary inflammation, there are:

(*b*) Certain **specific signs** of the action of a poison, in most instances peculiar, and frequently pointing directly to the poison employed.

This group is one of the utmost importance in Toxicology, and includes substances acting in many different ways, all, however, giving rise to the common symptom of gastric irritation.

CHAPTER XV.

SPECIFIC MINERAL IRRITANTS.

IODIN AND POTASSIUM IODID—BROMIN AND POTASSIUM BROMID.

IODIN is an active poison, although its effects are variable. Some persons will be violently affected by two or three grains, or even less, of potassium iodid, whereas others are

uninjured by half a drachm or a drachm for a dose.

The **symptoms** of acute poisoning by iodin itself consist of an acrid taste, tightness about the throat, epigastric **pain**, vomiting, and purging, especially if much has been taken. In a case which came under observation, a man took an ounce of the compound tincture of iodin, in mistake for a purgative draught. He was immediately seized with an intense burning pain in the throat and epigastrium, and vomiting, followed by great thirst, headache, and syncope. The vomiting was encouraged, large quantities of arrowroot given, starch enemata administered, and in twelve hours all the symptoms had disappeared, leaving him in a state of exhaustion, from which he recovered in a few days.

In chronic poisoning, or what is called **iodism** (which, however, in certain constitutions may be an acute symptom), the use of very small quantities of potassium iodid gives rise to signs of **irritation** of the **alimentary canal,** an **eruption** which may be measly, but which may also be distinctly a **form of acne, or even** like hydroa, **headache** about the region of the frontal sinuses, **dryness** and **irritation of the throat, ptyalism,** and **running from the nose** and **eyes,** with **reddening** of the **nostrils** and **eyelids.** These symptoms have no distinct relation to dose, for cases have occurred in the practice of the author where half a grain three times a day could not be borne. In *certain forms* of syphilis enormous doses (com-

pared with the above) may be given with advantage.

The **treatment** should consist in the encouragement of vomiting, and the free administration of amylaceous fluids, as gruel, arrowroot, boiled starch, flour and water; in fact, whatever is at hand in acute poisoning. This should be continued until the matters vomited are of their natural color; for so long as any iodin remains they will be rendered blue, starch iodid being formed. For iodism it is usually enough to discontinue the drug and use a little potassium chlorate gargle. There is no certain record of any fatal case.

TESTS.—1. Iodin may be readily detected by the blue color it gives to starch.

Potassium iodid gives the same when the iodin is set free by an acid, such as sulphuric acid.

2. It also forms a scarlet precipitate with mercuric chlorid, soluble in excess of either reagent; and

3. It gives a yellow precipitate with lead acetate.

BROMIN AND POTASSIUM BROMID.

BROMIN is an intensely acrid and powerfully corrosive fluid giving off very irritating vapors. It has rarely been used as a poison. In one case where an ounce of bromin was taken on an empty stomach, death ensued in seven hours. Besides the ordinary signs of irritant poisoning, the bromin had transuded the stomach and stained the tissues around.

Potassium bromid, now so largely used in medicine, gives rise in certain constitutions to an eruption something similar to that produced by potassium iodid, but not to the symptoms of coryza so marked in the latter.

CHAPTER XVI.

PHOSPHORUS.

PHOSPHORUS is comparatively more frequently used as a poison on the Continent of Europe than elsewhere.

It has been chiefly employed as rat poison (phosphorus paste) and match tips. To obviate such risks matches are often made without phosphorus, or with what is called the amorphous form, which is much less poisonous. A child has died from sucking two matches, and correspondingly small quantities have proved fatal to adults, but usually the quantity required is upwards of one grain.

In one case death followed in half an hour, but usually it does not occur till some days after the exhibition of the poison.

The **symptoms** of poisoning by phosphorus are very varied, often insidious, and might be described as naturally arranging themselves in two groups—(1) those following immediately on its ingestion, and (2) those coming on some hours after.

1. At first there may be merely the ordinary signs of irritant poisoning. The vomited matters *are* luminous in the dark, sometimes bil-

ius, sometimes bloody, or stained with the color of the matches or phosphorus paste. Sometimes the breath smells of garlic. There is very great prostration, and there may be diarrhea with bloody stools. These symptoms sometimes abate, and everything seems going on well, when suddenly, from the third to the fifth day, a new train of symptoms, still more serious, develop themselves.

2. These are such as would occur in the worst form of blood poisoning; harsh, dry **yellow** (jaundiced) **skin,** with discharges of blood from the various passages, and the formation of **extravasations** below the skin. The liver is enlarged. The urine is ordinarily retained or suppressed, what little there is being **albuminous** or bile-stained. Finally, acute delirium with convulsions sets in, and the patient dies comatose.

The **post-mcrten appearances** after taking phosphorus are very peculiar. If the case has proved rapidly fatal there are the ordinary signs of irritant poisoning, more or less distinctly marked. But if death occurs at a later period there may be softening of the stomach, extravasations in the skin and various parts of the body, so that in many respects the lesions resemble those of the worst forms of sea scurvy. The most marked changes are the remarkable fatty degeneration of the **liver, kidneys, heart,** and other **muscles,** especially of the first. The blood is usually fluid.

The **diagnosis** of poisoning by phosphorus will depend on the peculiar odor of garlic ex-

haled by the patient, and the luminosity of the breath and vomited matters, in addition to the other signs referred to. In many respects the signs, both before and after death, resemble acute atrophy of the liver.

TREATMENT.—There is no regular antidote for phosphorus; early evacuation by the stomach-pump and the free promotion of vomiting are the main points. Magnesia or its carbonate should be given freely in mucilaginous fluids. Oils had better be avoided, except for the purpose of removing all traces of the poison by the stomach-pump. Prompt treatment is all in all. Old oil of turpentine has been used with effect. Rinsing the stomach with a dilute solution of potassium permanganate has been advised.

DETECTION.—There is but one really satisfactory plan for detecting phosphorus in organic mixtures, that invented by **Mitscherlitch.** The suspected material is introduced into a retort, and acidulated with sulphuric acid. The stem of the retort is conducted into a tall glass vessel kept cool by a stream of water on the outside. The retort is heated, and distillation allowed to go on in the dark. If phosphorus be present it passes over as vapor, and is condensed in the cool vessel beyond. At each condensation a **flash of light is perceived,** which is the characteristic test relied on. The phosphorus may be oxidized by means of nitric acid and estimated as *phosphoric* acid.

Chronic poisoning by phosphorus occurs among match manufacturers. The subjects are attacked with toothache, the teeth become carious, and the jaw exposed. Thence the disease spreads, gradually extending and implicating the jaw-bone, and ultimately giving rise to great deformity.

CHAPTER XVII.

ARSENIC.

ARSENIC is by far the most important of metallic poisons, whether we consider the deadliness of its effects or the frequency of its use. It exists in several metallic ores, notably in iron pyrites, which being employed often as a material for the manufacture of sulphuric acid, renders arsenic one of the most frequent impurities of commercial oil of vitriol. This should never be forgotten in testing any substance for the poison. All forms and preparations of arsenic produce similar symptoms, and poisoning by either of them requires nearly the same treatment.

The peasants in parts of Styria and Hungary are said to eat arsenic, taking from two to five grains daily; the men doing so in order that they may gain strength, and be able to endure fatigue, the women that they may improve their complexions. These statements are so contrary to all that we know of the power of this poison, that they have been regarded as unworthy of credit. Evidence has,

however, been brought forward which shows clearly that arsenic eating occurs.

Copper Arsenite, known commercially as Scheele's green, emerald green, Brunswick green, etc., is sometimes employed in the manufacture of green paper-hangings, artificial flowers, toys, and even some kinds of confectionery. Too many cases of ill-health caused by this practice have been recorded to permit any doubt as to its deleterious effects. These are often manifested by people living in a room furnished with green paper-hangings. The chief symptoms are—sneezing, lachrymation, frontal headache, nausea, and loss of appetite, with colicky pains, thirst, etc. Among the workmen employed in preparing these paper-hangings more serious symptoms sometimes manifest themselves. The irritation of the pigment gives rise to circular patches of ulceration of the alæ of the nose, in the folds of the arm, in the groin and scrotum—in short, wherever dirt tends to lodge. These prove very intractable, except the employment is abandoned. The workmen who employ the pigment in its dry state suffer, while those who use it in a moist condition are less affected by it. A simple method for roughly detecting copper arsenite in these fabrics is as follows: A small portion of the suspected material is to be put into a test-tube with strong ammonia. If a blue tint be produced, a salt of copper is shown to be present. Withdraw the object, and drop a small piece of *ordinary caustic* (silver nitrate) into the am-

monium hydroxid: if arsenic be there, the silver nitrate will be covered with a yellow coating of silver arsenite, which will disappear on stirring. On igniting arsenical paper and allowing it to smoulder, the odor of garlic may be detected in the fumes given off. Reinsch's test (q. v.) may also be used for the detection of arsenic in fabrics, etc. Another mode in which the noxious effects of arsenic are produced is by the use of bright green tarlatans as ball dresses; when, as is often the case, the arsenic is left loosely adherent to ball-dresses and wall-papers, it is scattered in showers about the room.

ARSENOUS OXID (White Arsenic, Arsenic) (As_2O_3).—This is the preparation of arsenic most frequently used as a poison; the facility with which it used to be procured, its cheapness, and the ease with which it may be administered, all tended to recommend it to the murderer or suicide.

Arsenous oxid is found in commerce in the form of a white powder, or in small opaque cakes. It is tasteless, and not very soluble, an ounce of cold water dissolving about one grain. The quantity so held in solution may, however, be increased by dissolving the arsenic in boiling water and allowing it to cool. It is easily suspended in any viscid fluid, such as coffee, soup, etc.

Death has often occurred from a dose of arsenic in two or three hours, though it may not happen under four or five days, or even more.

The fatal dose is uncertain, but more than a few grains may be regarded as fatal. Enormous quantities, relatively speaking, have been taken, and when prompt vomiting occurred, recovery has followed. In the latter group of cases the poison has usually been mixed with some foreign body, or used in cakes, sweet-meats, or some other article of food.

SYMPTOMS.—The symptoms of poisoning by arsenous oxid usually commence within half an hour or an hour of swallowing the poison. These are—faintness, nausea, incessant vomiting, and a burning pain in the epigastrium, increased on pressure, and gradually extending over the whole abdomen. Next follow headache, mainly frontal, diarrhea, a sense of constriction and heat in the fauces and throat, great thirst and catching, painful respiration, the heart's action becomes depressed, the pulse is quick and feeble, there is great restlessness and anxiety, cold, clammy skin, and perhaps tenesmus, with heat and even excoriation round the anus. Death usually occurs within twenty-four hours.

These symptoms are liable to great variety.

1. **Pain and vomiting** may be absent.
2. There may be coma.
3. There is often spasmodic twitching or cramps, especially of the legs.
4. Sometimes there is tetanus.

In some instances death may take place from collapse, sometimes it follows on convulsions.

The **vomited matters** may be **clear** and **ropy**, or **red** or **brown** from admixture with blood or bile, or they may be **blue** or **black** if the arsenic has been colored with indigo or soot, as is sometimes done. Although the vomiting, pain, etc., are generally **continuous**, yet sometimes all the symptoms remit, and the patient rallies for a time, only to sink more rapidly.

The symptoms of **chronic** poisoning, such as result from wall-papers, are loss of appetite, a silvery coating to the tongue, thirst, nausea, colicky pains, diarrhea, frontal headache, languor, sleeplessness, cutaneous eruptions, soreness of the edges of the eyelids, emaciation and anemia. In some cases, when small doses have been administered for many days in succession, with the intent to destroy life, the symptoms have been masked by other substances. The most marked results of this practice have been sickness and vomiting, pain in the bowels, nervous irritability and emaciation. The practioner must be careful not to mistake these symptoms for those due to simple gastritis or enteritis.

Many cases of slow poisoning from arsenic in beer, derived from the glucose and invert-sugar used as substitutes for malt, occurred in England in 1900.

Arsenic is not a poison that permanently remains in the system, but is slowly eliminated from it, especially by the kidneys, but partly also by the bile.

The **local application of arsenic** to the mucous membranes, to wounds, or to surfaces de-

prived of their cuticle, produces constitutional effects similar to those just described. The only difference is that the symptoms show themselves more slowly. Not a few lives have been sacrificed from the application by ignorant quacks of a mixture of arsenous acid, realgar and iron oxid, to ulcerating cancers.

POST-MORTEM APPEARANCES.—Arsenic appears to exercise a specific influence over the alimentary canal, and more especially over the stomach; for in whatever manner it may have been introduced into the system, it is to this organ especially that we must look for its effects. These consist in the signs of acute inflammation commencing in the stomach, and often extending along the duodenum, small intestines, and colon. In acute cases the stomach is the viscus most affected; but in chronic cases the whole alimentary canal is found inflamed and ulcerated, particularly the duodenum and rectum. When death has occurred within five hours of taking the poison, the stomach has been found intensely inflamed in an adult; while the same result was witnessed in a child who died at the end of two hours. The stomach often contains a dark grumous fluid, mixed with tenacious mucus, occasionally tinged with blood. On removing the contents the mucous membrane is seen red and inflamed, the inflammation being most intense around certain spots. On examining these spots, particles of arsenic will probably be found adhering to the walls of the stomach *and surrounded* by a zone of inflammatory red-

ness. Sometimes also blood is effused into the visceral walls, giving rise to an appearance resembling gangrene. Ulceration of any of the coats of the stomach is rare, and perforation is still more so.

In a few exceptional cases there has been no appearance of inflammation in the stomach or bowels.

Putrefaction of the body is said to be remarkably retarded after death from arsenic.

TREATMENT.—The first object in dealing with a case of arsenical poisoning must be to get rid of the poison from the stomach; the vomiting must be promoted and the **stomach-pump** may be advantageously employed, or mild emetics administered if vomiting is not already going on. Albuminous or mucilaginous diluents must be freely used. Raw **eggs** beaten up in milk are particularly useful, as is likewise a mixture of albumen, milk, and lime-water; equal parts of **oil** and **lime-water** may be used, for the oil invests the poison, and the lime renders it less soluble. A large dose of castor oil (℥j to ℥ij) may be given, to carry off any of the poison which may have passed into the intestines, as soon as sickness has subsided. Freshly prepared ferric hydroxid should be administered moist, and in large doses, after the stomach-pump has been used; or indeed, this compound may be first injected and then withdrawn by the stomach-pump, thus washing out the stomach. **This is the most efficient antidote known.** The ferric hydroxid acts mechanically. It is best pre-

pared by adding magnesia to ferric chlorid solution, but can also be obtained by adding any caustic alkali or alkaline carbonate to any ferric salt. The pulpy, brown-red precipitate should be thrown on a muslin strainer, washed with cold water and administered in tablespoonful doses, best suspended in milk.

The subsequent treatment must be conducted on general principles, according to the severity of the symptoms; but the great depression must not be overlooked. Opium, combined with stimulants, ice internally, and hot fomentations externally, will frequently be found of great service.

TESTS.—In its **solid state** arsenous oxid may be known by the following properties:

1. Heated on platinum foil or on the point of a penknife, it produces a white odorless smoke, and is entirely volatilized. If thrown upon red-hot charcoal, the characteristic garlicky odor will be perceived.

2. If some of the powder be heated in a small test-tube, it will be sublimed, and small octahedral crystals, visible to the naked eye, or by lens, settle on the sides of the test-tube.

3. If arsenous oxid be mixed with freshly burnt powdered charcoal, and heated in a small test-tube, a ring of shining metallic arsenic of a gray color will be found on the cool portion of the tube, and an odor of garlic is perceptible. If this deposit be driven about from place to place it will gradually become oxidized, and octahedral crystals formed. Further, *if the tube be* divided and the part contain-

ing the arsenous (oxid) be washed out with distilled water, the liquid tests may be applied to the solution. This is called the **Reduction test.** It is very delicate.

In solution, arsenous oxid may be detected by what are called the liquid tests. A solution of it in water is **colorless,** almost **tasteless,** and has a very **slightly acid** reaction. If a few drops be evaporated on a glass slide and examined by the misroscope, numerous minute and mostly imperfect **octahedral crystals,** or an amorphous deposit, will be seen, presenting triangular surfaces by reflected light.

1. **Ammoniosilver nitrate** (prepared by adding a few drops of ammonium hydroxid to a solution of silver nitrate, till the brown silver oxid at first precipitated is nearly dissolved) throws down with arsenous oxid **a rich yellow deposit** of silver arsenite.

2. **Ammoniocopper sulphate** (formed by adding ammonium hydroxid to a solution of copper sulphate till the bluish-white copper hydroxid is almost redissolved) produces a **pale green precipitate,** copper arsenite, or Scheele's green. Care must be taken not to add too much of the test in the first instance, otherwise its blue may overpower the green of the precipitate.

3. **Hydrogen sulphid** throws down a **yellow deposit** of arsenous sulphid. Care must be taken that the liquid to be tested is not alkaline, or no precipitate will be produced, even though arsenic be present. For this reason

yellow ammonium sulphid will not precipitate arsenic until acidulated with pure hydrochloric, or some such acid. The precipitate should be collected, carefully washed, and dried. It should then be mixed with black flux or dry potassium ferrocyanid and reduced, so as to give rise to the mixed crust of metallic arsenic and arsenous acid produced in the reduction tests.

These tests are so delicate, especially the first mentioned, that they will detect the 8,000th part of a grain of arsenic in solution. They should be employed so that each may corroborate the other. But they are available only when the arsenic is in a pure state; they are worthless if any organic matter is present; hence are useless in testing in a poison case. There are several other processes for the detection of arsenic, especially in admixture with foreign substances, which require to be noticed namely—Marsh's process, the process known as Reinsch's process, Fresenius's process, and the Distillation process.

MARSH'S TEST OR PROCESS.—This process is founded on the fact that arsenous acid is decomposed by nascent hydrogen, and the consequent formation of gaseous hydrogen arsenid. This gas possesses the following properties: It burns with a bluish-white flame, and gives off a white smoke (arsenous oxid), which possesses a slight garlic odor. If a piece of glass or porcelain be held in the flame a blackish metallic stain will be deposited upon *it, consisting of* metallic arsenic. If the tube

through which the gas is passing be heated strongly, free arsenic will be deposited just beyond the point heated. These deposits might be confounded with those produced by antimony under similar circumstances. The antimonial stain is sooty, and has not a metallic luster. The arsenical stain is further readily dissolved by a solution of bleaching powder whilst the antimonial stain is not affected. A drop or two of ammonium sulphid will remove the antimony stain, but not the arsenic. To the stain may be added a few drops of strong nitric acid; it will dissolve the arsenic; if this be allowed to evaporate, and the acid be neutralized, a few drops of silver nitrate solution will give a brick-red precipitate of silver arsenate.

Marsh's test is best carried out in this way: A flask furnished with a cork, through which pass a funnel and a long bent tube drawn to a point, is prepared, so that the funnel reaches almost to its bottom. Several pieces of pure zinc are introduced, and then some sulphuric acid, diluted with about four parts of water, is poured through the funnel. In this way hyrogen gas is produced and escapes by the bent tube. When all the air has been expelled, the gas should be heated as it flows. If there be no deposit it is plain that neither the zinc nor the sulphuric acid contains arsenic. A portion of the suspected fluid is next introduced into the flask by the funnel, and the issuing gas again tested. Should a stain giving the characters alluded to above be produced,

the fluid contains arsenic in some form or other.

REINSCH'S PROCESS.—The liquid suspected of containing arsenic is:

1. Boiled with from one sixth to one eighth of its bulk of pure hydrochloric acid; and
2. A bright slip of copper introduced. If arsenic be present the copper will be coated with it, in the form of an iron-gray deposit. Next after removing the copper;
3. Washing it with distilled water, and
4. Drying it between folds of blotting-paper;
5. Cut it into slips, and
6. Introduce it into a reduction-tube and
7. Apply heat.

If arsenic be present, arsenous acid will be sublimed and deposited on the sides of the tube, in the form of minute octahedral crystals. These may be dissolved in water and tested in the usual way. Before resorting to this test, the hydrochloric acid, as well as the copper foil, must be examined to make sure of their purity. This is easily effected by boiling the copper with a mixture of the acid and distilled water before the suspected liquid. The varieties of copper in common use for Reinsch's process often contain arsenic. A copper of ascertained purity must therefore be used.

ARSENIC IN ORGANIC MATTERS.—The following process, termed the **Process by Distillation,** which has been introduced by Dr. *Taylor,* is a very convenient one. The suspect-

ed matters are to be thoroughly dried in a water-bath or otherwise, taking care not to use too great a heat. They are then to be introduced into a flash fitted with a long bent tube; to the dried material is to be added a quantity of strong hydrochloric acid, proved free from arsenic, sufficient to drench it, and the whole allowed to digest for some hours. At the end of that time heat is to be applied to the flask by means of a sand-bath, and a receiver fitted to the bent tube. The receiver should contain a little water, and both it and the bent tube should be kept cool. As distillation goes on the arsenic passes over in the form of arsenous chlorid, and is collected in the receiver beyond. A second portion of hydrochloric acid may be used to remove any traces of arsenic in the organic material. The arsenic may be recovered from the chlorid by boiling with pure polished copper, as in Reinsch's process.

The process of Fresenius and Von Babo, given at page 33, is especially adapted for the recovery of arsenic from organic admixture, and is probably the best.

Several cases of poisoning by **hydrogen arsenid,** when this gas has been accidentally inhaled, are on record, some proving fatal. This may occur when hyrogen has been prepared from impure zinc and sulphuric acid, when intended for the purpose of inhalation. The symptoms much resemble those of ordinary arsenical poisoning.

CHAPTER XVIII.

ANTIMONY AND ITS COMPOUNDS.

In its metallic state antimony is not regarded as poisonous. Two of its preparations, however, claim attention, namely, tartar emetic, and antimony chlorid.

TARTAR EMETIC (Tartrated or Tartarized Antimony, Potassio-Antimony Tartrate; Tartar Emetic).—This compound has been sometimes administered or taken without any serious result, a circumstance in large doses which may be accounted for by the promptitude with which it excites vomiting and purging. Given in small doses, frequently repeated, the effects of tartar emetic may be made to simulate, in some degree, those due to natural diseases.

A dose of three quarters of a grain killed a child. The fatal dose cannot be stated with certainty; a dose of two grains has destroyed an adult, under circumstances which favored its action; but the ordinary fatal dose is not less than a dram; more may be taken (as much as half an ounce or more) and recovery take place, vomiting so speedily following on its being swallowed.

Symptoms.—In acute poisoning by this agent there is a **metallic taste** noticed at once, **nausea,** and **violent vomiting,** with **retching, burning heat,** with **pain** in the **stomach,** and **purging. Difficulty in swallowing, thirst, cramps, cold perspiration** and **great debility**

soon set in. Should the case terminate fatally, death may be preceded by giddiness, insensibility, difficult respiration, utter prostration, with violent spasm, tonic or clonic, but even when matters appear to be most critical, symptoms of improvement are often manifested, and recovery gradually follows.

The effects of **chronic** poisoning by antimony are, constant nausea, frequent attacks of vomiting and purging, a loathing for food, a weak pulse, loss of muscular power, cold clammy sweats, and fatal exhaustion. The symptoms are of course aggravated after each administration of the poison, whether given in food or medicine. These features were well brought out in the case of Pritchard's mother-in-law.

Tartar emetic ointment applied to the **skin** produces a **pustular** eruption like that of small-pox; while, if much be **absorbed**, there will be **nausea, sickness,** etc. Sometimes this same eruption appears in the throat and on the skin, after **swallowing** a large dose.

POST-MORTEM APPEARANCES. — The most common are inflammation of the throat, stomach, and intestines. Sometimes the mucous membrane of the stomach is softened and infiltrated with blood. The cecum and large intestine may also be inflamed especially if life has been prolonged after the dose, as in chronic poisoning. The brain and lungs have been found congested.

TREATMENT.—Vomiting should be encouraged by warm greasy water, milk, etc. Liquids containing **tannin,** as **tea,** without milk or

sugar; **decoction of oak bark,** etc., must be freely given. **Cinchona bark** in tincture or powder may be advantageously prescribed. Afterwards opiates may be administered.

TESTS.—Tartar emetic is soluble in water, but not in alcohol.

In solution, tartar emetic may be thus described:

1. A drop evaporated on a glass slide leaves microscopic crystals, either tetrahedral or cubes, with edges bevelled off.

2. The solution may further be proved to contain antimony by passing through it hydrogen sulphid, or adding to it ammonium sulphid, either of which throws down an orange-red precipitate of antimony sulphid. This precipitate is soluble in strong hydrochloric acid, which solution, being diluted, throws down a white precipitate.

This characteristic orange precipitate is only produced in a perfectly pure solution. The presence of organic matter very much interferes with it; moreover, it has been found that a highly organic mixture (such as the contents of a stomach), especially if mixed with a coloring matter, and strongly acidified, will yield with hydrogen sulphid, after continued action, a dirty, reddish-brown precipitate, which might easily be mistaken for an impure precipitate of antimony sulphid.

3. Dilute mineral acids (nitric is best) throw *down* a white precipitate with tartar emetic,

which is soluble in excess of the acid used, or in tartaric acid.

The metal may be separated from organic substances by Marsh's or Reinsch's process, for detailed description of which see under "Arsenic" (pages 90-2).

ANTIMONY CHLORID (Terchlorid or Butter of Antimony) is a powerfully corrosive liquid. It produces violent inflammation and corrosion of the whole intestinal canal; occasionally also drowsiness or insensibility.

A man took from two to three ounces of this substance, which proved fatal in ten hours and a half, after producing great prostration, nausea, violent griping pain, and tenesmus followed by a tendency to sleep. On inspection, the whole of the inside of the alimentary canal was blackened, as if it had been charred; there was but little mucous membrane remaining, and the parts were much softened.

In two other cases where the liquid proved fatal, about three ounces were used. Death occurred in eighteen and twenty-four hours respectively. In one it is stated that the mind remained clear; in the other this is not referred to, but there was no purging. In both the stomach was much changed and blackened.

TREATMENT.—Magnesia must be administered with **abundance** of milk or water, together with the remedies recommended in poisoning by tartar emetic.

CHAPTER XIX.

MERCURY AND ITS COMPOUNDS.

Of the preparations of Mercury, **corrosive sublimate** is the most important to the toxicologist; for although they all possess in a greater or less degree poisonous properties, yet the instances in which the other compounds have been used to destroy life are extremely rare. The treatment in all cases must be the same. It is worthy of remark that mercury, whilst in the metallic state, is destitute of injurious properties, but if oxidized or otherwise rendered fit for absorption, it may give rise to dangerous symptoms. Thus, workers in mercurial mines suffer much, as did those who were employed in silvering looking-glasses by the old process. Large doses (from half a pound to two pounds) have been given in obstinate cases of constipation, intussusception, etc., with much folly, but without any remarkable effect.

CORROSIVE SUBLIMATE (Mercuric Chlorid, Bichlorid of Mercury).—This preparation of mercury, **which, strictly speaking,** were it not for its specific effects, **belongs, like zinc and antimony chlorids, to the class Corrosives,** is sually met with in the form of imperfect crystalline masses or as a white powder. It has an acrid, coppery, or metallic taste, so powerful that but little could be swallowed without the individual becoming aware of it. *It is very so*luble in water.

Three grains is the smallest quantity that has been know to prove fatal; and from this to **five grains** may probably be stated as the average dose necessary to destroy life. Recovery has taken place after as much as eighty grains had been swallowed. Death has occurred in less than **half an hour**; while, in some instances, life has been maintained until the sixth day, and in one instance (where between three and four scruples had been swallowed) until the twelfth day. The average duration of fatal cases is from two to six days.

SYMPTOMS.—In the majority of cases the symptoms of poisoning by corrosive sublimate commence **immediately**, with an **acrid metallic taste**, often described as coppery, and a sense of constriction and **burning heat in the throat and stomach.** The burning pain gradually extends over the abdomen, and is much increased by pressure. There is nausea, with vomiting of the contents of the stomach. These matters are somewhat mixed with blood and stringy masses of mucus. The sickness is accompanied by diarrhea, **with bloody stools**, or dysentery and swelling of the abdomen. The countenance becomes flushed and often swollen, though it is occasionally pallid and anxious. **The lips and tongue are white and shrivelled.** There is frequently dyspnea, while the pulse is small or wiry and frequent. Note well that pain may be absent. Death is brought about by **collapse, coma**, or **convulsions.** The symptoms marked by bold-face serve to distinguish poisoning by corrosive sub-

limate from most other specific irritants; but the most characteristic are those which come on should life be prolonged—the so-called **secondary** symptoms.

For should the poison not prove rapidly fatal, the pain gradually lessens, though attacks of colic and nausea may come on at intervals for several days. Often the urine is suppressed, and after a time there are symptoms of hectic fever, with much depression. The gums and salivary glands also become swollen, there is a coppery taste, the breath is very fetid, and there is severe ptyalism or salivation. This latter effect is the most prominent feature in the **chronic** form of poisoning, where small and frequently repeated doses have been given; it is often so severe as to cause death when the patient would otherwise probably recover.

It must not be forgotten that **salivation** sometimes arises when no mercurial of any kind has been given. Thus the mineral acids, arsenic, bismuth, lead, potassium iodid, opium, etc., may induce it in some very peculiar constitutions. Small medicinal doses of mercury, such as a few grains of calomel even, may also excite it in certain individuals, especially where it does not purge; and in persons suffering from renal disease. It may also occur spontaneously, as in stomatitis, or inflammation of the mouth, especially in children; and very troublesome examples of it may occur in pregnant women.

It is strange that neither in acute nor chronic mercurial poisoning do we observe any

marked loss of muscular power. Yet workers in quicksilver, becoming gradually poisoned, owing to the absorption of the fumes of mercury during respiration, are very apt to suffer from a peculiar kind of **tremor**, sometimes called palsy. This commences in the upper extremities, with inability to direct the hands and arms, and goes on to a shaking or trembling of all parts of the body.

POST-MORTEM APPEARANCES.—The appearances produced by corrosive sublimate are confined chiefly to the digestive canal. The mucous membrane of the mouth, fauces, and esophagus is softened and of a whitish or bluish-gray color. The stomach also presents marks of violent inflammation; beneath the mucous membrane numerous patches of extravasated blood are seen, and frequently corrosion or ulceration has been found. The large and small intestines, the peritoneum, and especially the urinary organs, often appear inflamed. If life is prolonged for a few days the rectum and lower bowels are usually found intensely congested.

TREATMENT.—The antidote for corrosive sublimate is raw **white of egg**, or the whole egg broken up with milk or water. **Vomiting** is best promoted by administering copious draughts of fluids containing albumen; but if necessary, ipecacuanha may be given. Glutin has been much recommended, and may readily be prepared by washing flour in a muslin bag under a stream of water; but in an emergency it will be best to exhibit the flour at once,

made into a paste with milk or water. The free use of demulcent drinks, milk and ice, will be very grateful to the patient's feelings. Gargles of borax or potassium chlorate do some good. Opiates may be given in small doses, if there is much pain and we should allow only a milk or farinaceous diet. The most useful remedy, however, in chronic poisoning is potassium iodid; for this salt destroys the compounds formed by the union of mercury with certain of the tissues, and eliminates the poison through the kidneys.

TESTS.—Corrosive sublimate is completely **volatilized** by heat.

1. **Sodium hydroxid** added to its solution gives a **yellow precipitate.** This precipitate if washed, dried and heated in a test-tube, gives a ring of metallic mercury in the form of globules in the cool part of the tube. In like fashion corrosive sublimate itself may be reduced and volatilized if heated with black flux or freshly burned charcoal.

2. On adding a solution of **potassium iodid** to a small quantity of the solution, a (a) bright scarlet precipitate, (b) soluble in excess of either reagent, is produced. Hence a single drop of the iodid may cause a red cloud, which disappears, to reappear on adding another, until the precipitate forms permanently. Too much of the iodid will redissolve the precipitate and form a nearly colorless or slightly yellowish solution.

3. If a drop or two of a solution of corrosive *sublimate,* slightly acidulated with hydro-

chloric acid, be placed on a gold coin, and the solution and the gold be touched with a piece of zinc or an iron key, the mercury will be deposited as a bright silvery stain on the gold. The same plan may be adopted with a gold ring. This constitutes at all times a ready method of testing for mercury.

CALOMEL (Mercurous Chlorid) is a heavy white powder, which is usually regarded as a safe medicine. Yet in some peculiar constitutions it has caused excessive salivation and death, even though only a few grains have been given. In large doses it may be regarded as an irritant poison. It is distinguished from corrosive sublimate by forming a black precipitate with caustic potash, and by its insolubility in water.

The remaining preparations of mercury, which in rare instances have been used as poisons, are the **Red Oxid** (red precipitate); the **Red Sulphid** (cinnabar, or vermilion); the **Cyanid**; the **Nitrates** and the **Subsulphate, Turpeth Mineral.**

Mercury may be separated from organic admixture by **Reinsch's method.**

CHAPTER XX.

PREPARATIONS OF LEAD.

LEAD, in its metallic state, is not injurious, but it is readily converted into carbonate or other poisonous compounds, the chief of these being the acetate, subacetate and the carbonate.

LEAD ACETATE (Sugar of Lead).—This is sold as a glistening white powder, or in the form of crystalline masses resembling loaf sugar. It is very soluble in water, and has a sweetish metallic taste, but cannot be called a very active poison.

In one instance thirty pounds of this substance were accidentally mixed at the miller's with eighty sacks of flour. This was made into bread, from eating which 500 persons suffered severely. The chief symptoms were a sense of constriction in the throat and at the pit of the stomach, crampy pains round the naval, stiffness of the abdominal muscles, paralysis of the lower extremities, constipation, scanty urine, and the formation of a deep blue line on the gums. Although in many cases there was great prostration, with other alarming symptoms, yet under the use of purgatives, all recovered. It was noticed that after a temporary convalescence many of the symptoms returned in an aggravated form without any apparent cause. Note that in poisoning by lead, **constipation,** not **purging,** is the rule, though sometimes there has been vomiting and purging, and there is great prostration, with cramps and convulsions.

POST-MORTEM APPEARANCES.—They are not usually very distinct. The stomach and intestines have been found inflamed, and the surface of the former softened. There may be no characteristic signs beyond the blue gums, *in* chronic poisoning.

LEAD SUBACETATE (Goulard's Extract).—This substance is known to have proved fatal in three or four instances, after having caused great agony. It is a more powerful poison than the acetate. It is found in the shops as a milky liquid, due to the conversion into the insoluble carbonate by the action of the carbonic acid contained in the atmosphere.

LEAD CARBONATE (White Lead, Ceruse, etc.).—This is sold in heavy white masses, looking like chalk. It is readily acted on by acid, but very insoluble in water.

Lead carbonate derives its greatest interest from the chronic-form of poisoning which it produces among white-lead manufacturers, painters, etc., known as **"the painters' colic,"** which too often terminates in **"lead palsy."** In these instances the lead finds its way into the system by absorption from the **digestive canal, the lungs,** or the **skin;** producing its characteristic effects, especially "dropped wrist," when a sufficient amount has been absorbed. It is this salt which is formed by the action of air and water upon lead.

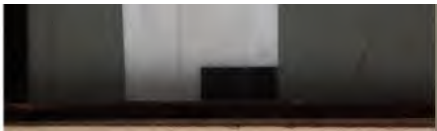
The other preparations of this metal do not require any separate notice.

TREATMENT.—**Sodium sulphates, magnesium sulphate** or **alum** may be freely given, dissolved in water; the object being to convert the salt of lead into the insoluble **sulphate. Milk,** or **milk and eggs** will be useful. If vomiting is absent, an **emetic** of **ipecac** should be administered or the stomach-pump be employed.

TESTS.—The presence of a salt of lead in solution may be thus ascertained: 1. On passing **hydrogen sulphid** through it, or on adding a few drops of ammonium sulphid a **black precipitate** is given. 2. A **white precipitate** results from the use of **ammonium hydroxid.** 3. Dilute **sulphuric acid** gives a similar precipitate, which is **insoluble in nitric acid.** 4. **Potassium iodid** affords a **bright yellow deposit** (lead iodid).

CHRONIC LEAD-POISONING.—The chronic and insidious effects produced by lead upon the constitution are deserving of careful attention. Water impregnated with this metal in its passage through lead pipes or cisterns, acquires poisonous properties. Lead-pigments are sometimes improperly used to color cheese, lozenges, snuff, etc. Chrome-yellow (lead chromate), used as substitute for eggs in pastry, has been a peculiar cause of chronic poisoning. Dr. D. D. Stewart discovered many cases in Philadelphia due to this cause. In Devonshire (Eng.) colic was caused by the absorption of lead from cider, which had been made in vessels partly or wholly composed of lead; and in the wine district of Pictou attacks of colic were so common, from the impregnation of wine with this metal, that we still speak of lead colic as "colica Pictonum."

The pernicious influence of lead is manifested among those engaged in the manufacture or *use of* lead compounds, especially painters,



lead smelters, plumbers, color grinders, shot manufacturers, workers in sugar of lead, potters, compositors, enamellers of cards, etc. These artisans should be advised to prevent disease by great cleanliness, the occasional use of alkaline sulphates as purgatives, and by drinking freely of sulphuric acid lemonade. The substitution of moist for dry color grinding has proved useful.

The most prominent **symptoms** of chronic poisoning by lead are as follows: A **blue line or blue spots on the gums,** and the liability of the latter to bleed from any slight cause; **emaciation, pallid complexion,** anemia, and a feeble quick pulse; **obstinate constipation, with attacks of colic relieved by pressure;** diminution of the renal secretion and rheumatic pains; afterwards comes weakness of the hands, wrists, and arms, ending in **paralysis of the extensors,** or "dropped wrist," the paralysis gradually creeping up the arms.

The TREATMENT of these cases must consist in the first instance in the use of saline purgatives, with dilute sulphuric acid. A favorite remedy of all others in chronic cases is potassium iodid, in five or ten grain doses thrice daily; this agent acting most beneficially when employed in conjunction with galvanism to the paralyzed limbs.

CHAPTER XXI.

SALTS OF COPPER.

POISONING with the salts of copper is a comparatively rare occurrence; when it happens it is generally the result of accident. The metal itself is not poisonous, but the action of the gastric juice may produce a very deleterious salt. Copper coins, when swallowed sometimes on this account prove mischievous though usually any ill effects which ensue are due to their mechanical action. Salts of copper have been accidentally introduced into the system by means of food which has been cooked in copper saucepans. Much trouble has been taken under adulteration acts to repress the sale of preserved vegetables, tined green by copper; but no real instance of any actual ill effect from such substance has ever been educed. The most important substances of this class to the toxicologist are the following:

COPPER SULPHATE (Blue Vitriol or Blue stone) is met with in large crystals, which are very soluble in water, and possess an acrid metallic taste. In doses of half an ounce it acts as a powerful irritant, and has sometimes been used as an emetic. It has been administered to procure abortion. In the case of a child sixteen months old, who sucked some pieces of bluestone with which she was playing, death occurred in four hours.

COPPER SUBACETATE (Verdigris).—This *preparation is* met with in masses, or in the

form of a greenish powder. It possesses a powerful astringent metallic taste. It is often produced by allowing greasy substances to stand in copper saucepans. It has proved fatal in half-ounce doses.

COPPER ARSENITE (Mineral Green).—Derives its poisonous properties chiefly from the arsenic which it contains, and is referred to under that heading.

SYMPTOMS.—The symptoms of poisoning by salts of copper, are mainly: **Pain** in the epigastrium, gradually extending over the abdomen, violent **vomiting**—the vomited matters being of a blue or green color—and **diarrhea**, are the symptoms which set in the most speedily. Then there is usually dyspnea, great depression, coldness of the extremities, headache with giddiness, and slight tetanic convulsions. Sometimes there is suppression of urine. **Jaundice** very frequently occurs—a symptom the more important, as it is rarely met with in other forms of poisoning, save those by phosphorus. Occasionally stupor, coma, and paralysis supervene. Should death ensue, it may occur within a few hours, or not for several days.

The salts of copper taken in very small doses, for several days, give rise to a metallic taste, thirst, debility, cramps and colicky pains, with symptoms of dysentery. In some instances there have been found retraction of the gums, with the formation of a purple line, very distinct from the blue mark due to lead.

POST-MORTEM APPEARANCES.—Evidences of

inflammation are usually found in the stomach and intestines, the mucous membrane being often ulcerated and of a blue-green color. Particles of the poison may sometimes be found adhering to the coats of the bowels. Perforation of the intestines has occurred.

TREATMENT.—Vomiting sets in spontaneously, and is to be encouraged by the use of warm water. The stomach-pump will rarely be needed. The only effectual antidote is **albumen.** The whites and yolks of several eggs should therefore be given, followed immediately by milk or mucilaginous drinks.

TESTS.—Solutions of copper salts are blue or green. The metal may be thus identified:

1. A **polished knife** or needle introduced into the solution slightly acidulated is soon covered with a bright red **coating of copper.**

2. **Ammonium hydroxid** produces with a salt of copper a **bluish precipitate,** readily soluble in excess of ammonia, and then forming a splendid blue solution.

3. **Potassium ferrocyanid** gives a **claret-colored gelatinous precipitate,** if the copper be abundant; otherwise the deposit is of a light brown.

4. **Hydrogen sulphid** yields a **deep-brown precipitate.**

5. A few drops of the **copper solution** are to be placed on **platinum** foil, and slightly acidulated; on touching the foil, through the solution, with a strip of zinc, **metallic copper** is *depo*sited on the platinum.

CHAPTER XXII.

SALTS OF BARIUM.

THREE preparations of barium have caused death—viz., the **chlorid, nitrate,** and **acetate.** These also give rise to specific nervous symptoms, as **cramps** and **convulsions.** Loss of voice has been specially noted in several cases. Consciousness is not impaired. In animals much urine seems to be passed. After death inflammation of the rectum has been usually found, besides the usual marks of irritant poisons in the stomach and bowels.

Barium salts are used in sizing cotton warps, and as a poison for rats and mice; hence accidents are likely to arise from them.

Barium Chlorid.—Half an ounce has proved fatal in two hours, after causing symptoms of irritation, with vertigo, paralysis, and convulsions.

TREATMENT.—Sodium sulphate or magnesium sulphate should be administered, by which the poison will be converted into an inert, insoluble sulphate. Emetic should also be given, or the stomach-pump used.

CHAPTER XXIII.

SPECIFIC VEGETABLE IRRITANTS.

LABURNUM (Cystisus laburnum).—Every portion of this plant is poisonous. The seeds are frequently eaten by children, and give rise to vomiting and purging, with dilatation of the pupils, rigors, rigid limbs, etc.

Œnanthe crocata, Phellandrinum aquaticum, Æthusa, Cynapium, etc., strictly speaking, belong to this group.

BLACK HELLEBORE (Helleborus Niger) or **Christmas Rose,** when eaten, gives rise to abdominal pain, vomiting and purging, vertigo, cold sweats, and collapse, resembling that of malignant cholera. An infusion of this plant is sometimes administered by quacks to destroy intestinal worms. It has proved fatal to children under these circumstances.

Several other substances variously grouped for the sake of convenience should come under this heading.

CHAPTER XXIV.

SPECIFIC ANIMAL IRRITANTS.

CANTHARIDES (SPANISH FLIES).

THIS poison is well known, and is usually administered in the form of powder or tincture. Of the former, twenty-four grains have destroyed life; of the latter, one ounce. This poison has been employed as an aphrodisiac, and to induce abortion, by persons ignorant of its dangerous effects. This is, perhaps, the most frequent cause of poisoning by cantharides. Applied externally it has proved fatal, as in the case of a girl affected with scabies, who anointed the whole of her body with cantharides ointment in mistake for that of sulphur. She died in five days, after suffering from the symptoms of poisoning by cantharides. In a Cornish case, in which some of *this substance* was administered with criminal

intent, the prisoner was discharged, on the ground that enough had not been given to produce poisonous effects.

It produces an acrid taste, vomiting, purging, burning heat in the stomach, pain in the loins, **severe strangury, bloody urine** and **priapism.** Then there is faintness, with giddiness, the limbs become rigid, and delirium, with convulsions, precedes death. Sometimes the **matters ejected** from the stomach or passed in the stools contain **shining golden** or **green particles,** the remains of the wing cases of the beetles, which constitute the drug, readily seen with a lens, or even with the naked eye.

After death, marks of inflammation are found in the alimentary canal, kidneys, and bladder, and the genital organs.

TESTS.—The detection of Spanish flies, if taken solid, depends mainly on the presence of the **shining particles** already alluded to, in the stomach, or in the vomited matters. To make their nature certain, however, an extract of the suspected materials should be prepared, and this should be treated repeatedly with chloroform or ether. This fluid is to be allowed to evaporate till only a few drops are left, which may be applied on lint to some portion of the body where the skin is fine, as the forearm, the part being covered by a bit of isinglass plaster, or gold-beater's skin. The **vesication** produced is the test of the presence of cantharides.

No antidote is known. Vomiting must be excited or encouraged; and linseed tea, and gum water, or gruel, copiously administered.

IV.—NEUROTIC POISONS.

CHAPTER XXV.

NARCOTICS.

NEUROTICS ACTING ON THE BRAIN AND PRODUCING SLEEP.

OPIUM.

OPIUM is the juice of the unripe capsules of the **Papaver somniferum,** or white poppy, and is a very complex substance. Its principal properties, however, are due to the presence of **morphin,** as meconate; but others of its constituent substances undoubtedly modify its action.

It is sometimes used as a poison in its crude state, but more frequently in solution in alcohol, forming tincture of opium, or laudanum. Opium is the chief ingredient in most soothing syrups for children, to whom opium is at all times especially dangerous; and many who do not die from its direct effects, do from the wasting indirectly produced.

The smallest quantity of **laudanum** which is known to have proved fatal to an adult is **two drams** (equivalent to about ten grains of opium), from which death occurred in seven hours. Half an ounce has more than once *proved fatal.* Two grains and a half of an

extract, said to be equal to four grains of crude opium, have produced a similar result. Much larger doses are, however, taken with impunity on many occasions, more especially by those habituated to the use of this drug, who remain almost unaffected by surprisingly large quantities. De Quincey, the English opium-eater, once found in a pirated edition of "Buchan's Domestic Medicine," a caution against taking more than "twenty-five ounces" of laudanum at one dose. He says that he always bore this excellent advice in mind; and it does not appear that he ever took more than sixteen ounces of the tincture of opium as his daily allowance. In certain diseases, patients quite unaccustomed to the use of sedatives can take excessive amounts without narcotism being produced.

On the other hand, it must not be forgotten that not a few individuals are unable to take even one third of a grain without becoming narcotized. Young children are particularly susceptible of its effects; the tenth and twelfth parts of a grain having respectively proved fatal to infants two and five days old; and there is recorded the case of an infant seven days old, who died comatose eighteen hours after having had administered to it about the twelfth of a grain of opium, or the quantity contained in one drop of laudanum. Under this head it should be remembered that old laudanum, kept for a long time in a bottle is much stronger than when freshly made. The smallest fatal dose for a child (four weeks

old) on record, is one of paregoric elixir equivalent to about one **ninetieth** of a grain of opium. On the other hand, they sometimes recover from very large doses indeed.

The duration of a fatal case is generally from **seven to twelve hours.**

The shortest period recorded is **three quarters of an hour;** the longest **twenty-four hours.** In one case two days is mentioned. If the patient survives twelve hours there is good hope of recovery.

In judging of reported cases of laudanum poisoning it must not be forgotten that that which is sold without prescription is often very dilute.

The quantity of MORPHIN found in good opium is about sixteen per cent. The chief salts of this alkaloid are the **acetate,** the **hydrochlorate,** and the **sulphate,** all being very energetic poisons. They cause symptoms similar to those about to be described as produced by opium. But, in addition, there has been especially noticed great itching of the skin, convulsive twitchings of the muscles of the face and limbs, and occasionally tetanus. Small doses of any of the salts of morphin may cause death. In a delicate woman half a grain is supposed to have proved fatal; in several instances one grain has proved fatal; and certainly a dose of two grains might kill a healthy adult unaccustomed to opiates. Nevertheless, under the influence of custom, large quantities may be taken. A young lady took *daily fifteen grains* of the morphin hydro*chlorid without* obtaining more than two or

three hours' sleep from it; while for many days in succession, when suffering much pain, she increased the quantity to one scruple. The hypodermic injection of the morphin has been similiarly abused. In one case where a third of a grain was thrice repeated as an injection beneath the skin, death followed in six hours.

Others of the opium alkaloids are poisonous; but the instances of poisoning by them are quite rare.

SYMPTOMS.—When a large dose of opium or its preparation has been taken, the symptoms usually manifest themselves in about twenty or thirty minutes. They commence with giddiness, drowsiness, and stupor, then ensues insensibility. The patient appears as if in a sound sleep, from which he can be aroused by a loud noise, etc., although he quickly relapses. As the poisoning progresses the breathing becomes slow and stertorous; the pulse, which at first was slow and full, becomes weak and feeble, and the countenance livid. The eyes are closed, while the pupils are generally contracted, often almost to the size of a pin's point, and insensible to the stimulus of light. In some instances the skin is cold and livid, in others it is bathed in sweat. So also the countenance may be either ghastly or placid, the pupils may even be dilated, and the pulse may be unaffected, or so small and frequent as to be scarcely appreciable. Vomiting sometimes occurs, with slight reaction, so that hopes of recovery are entertained. But frequently there is a relapse, the comatose state returns, and

death quickly follows, occasionally preceded by convulsions.

The possibility of rousing a patient during the earlier portion of the progress of these symptoms will assist in diagnosing the effects of poisoning by opium from those due to apoplexy, epilepsy, etc. The contracted condition of the pupil will also assist; but it must not be forgotten that in lesion of the pons Varolii the pupils are also contracted. When permanent recovery ensues it is complete; but it is usually preceded for a day or two by severe nausea, sense of weariness, constipation and headache.

POST-MORTEM APPEARANCES.—The appearances in acute poisoning by opium are not very characteristic. The most prominent are, great turgescence of the vessels of the brain, with effusion of serum into the ventricles and at the base. The turgid condition of the vessels often continues down the spinal cord. The lungs are usually gorged with fluid blood, and the right side of the heart distended with dark fluid or clotted blood.

TREATMENT.—The first object in dealing with a case of opium poisoning is to remove all the poison from the stomach. This may be often effected by washing out the stomach. Potassium permanganate decomposes morphin rapidly and a dilute solute has been found to be an efficient antidote. Five grains dissolved in four ounces of water is a good solution. This may be repeated every thirty minutes *until several* doses have been taken. Efforts

should be made to keep the patient awake, but violent means should not be employed. Atropin which was at one time much in favor as a physiologic antidote is of doubtful value. Reichert has shown that it may be of some use in the second stage but only then with caution.

The treatment recommended must be **perseveringly used,** remembering that as long as life lasts hope of recovery is not to be banished. In the great majority of cases the treatment is successful, and thus to gain time is to save life. The first twelve hours is usually the most dangerous period.

TESTS.—There are no direct means by which opium, as such, may be detected. We endeavor therefore to obtain evidence of the presence of **morphin** and **meconic acid.** The two substances may be separated from organic admixture by the following process:

1. The suspected matters should be well boiled with distilled water, and spirit acidulated with acetid acid, and strained.

2. To the fluid which has passed through, lead acetate is to be added until precipitation ceases, and the whole—

3. After standing, is to be thrown on a filter. The insoluble lead meconate remains on the filter, the soluble morphin passing through as acetate.

A. To separate the meconic acid the substance on the filter is to be diffused through water, and hydrogen sulphide passed for a time. Lead sulphid is thus thrown down, and may be separated by filtration, the meconic

acid remaining in solution. On concentration, this should give the requisite reactions.

B. In the search for morphin, the filtered fluid above referred to is also to be treated with hydrogen sulphid to secure the removal of excess of lead, which is next to be carefully separated from it by further filtration. The fluid now passing through, containing the morphin acetate, is next to be concentrated by evaporation over a water-bath. The acetate may be dissolved ont of the mass in dilute alcohol (it is not soluble in ether) again filtered, the filtrate being finally evaporated to dryness and tested.

MORPHIN.—The best tests for this alkaloid, in substance or in solution (substance is preferable) are:

1. **Nitric acid,** which strikes an **orange-red color,** varying in intensity with the strength of the acid, and the concentration of the morphin solution. Ruddy fumes are also developed.

2. **Neutral ferric chlorid** strikes a rich **blue color** with morphin when added in small quantity; if added in excess, the yellow of the test, combining with the blue, may produce a green. This blue is **destroyed by acids** and by heat. Nitric acid not only destroys the blue produced by this test, but places it with the orange-red color; so that the nitric acid may be applied to the same portion of morphin after the iron test, but not vice **versa.**

3. Iodic acid. This acid becomes decom-

posed, owing to the reducing action of morphin, **setting free the iodin.** The latter is detected by its **brown color,** and the **blue,** which it strikes **with starch.** The iodic acid should be previously tested to ascertain its purity, as it occasionally contains free iodin.

MECONIC ACID.—This is obtained from solutions of opium, in the form of little scale crystals of a reddish tint, which are decomposed by heat and partly sublimed. In solution it may be detected by its acquiring a **blood-red color** on the addition of **ferric chlorid.** A similar color is produced with iron by potassium sulphocyanate, as found in the saliva; but the color of the meconate is not discharged by gold chlorid, or corrosive sublimate; that of the sulphocyanid is.

NARCOTIN dissolves in sulphuric acid with a yellow color, converted into a carmine red by the addition of a trace of nitric acid.

CHAPTER XXVI.

ANESTHETICS.

NEUROTICS ACTING ON THE BRAIN AND PRODUCING LOSS OF SENSATION.

CHLOROFORM—CHLORAL—METHYLENE DICHLORID—ETHER—NITROUS OXID.

AMONG the anesthetics which have been employed in the practice of medicine are chloroform, ether, methylene dichlorid, nitrous oxid, and amylene. Any of these agents may cause death when introduced into the system by inhalation.

CHLOROFORM is a colorless, heavy volatile liquid; having a fruity ethereal color and a sweet pungent taste. It is readily soluble in alcohol, but very sparingly so in water.

The **symptoms** produced by the vapor of chloroform may be divided into three groups of varying intensity; briefly they are these: First, a degree of relief from pain, with slight stimulation, the senses being but slightly affected; second, a stage of excitement and incoherence, wherein the patient is prone to struggle; and thirdly, a stage of which the most marked features are complete insensibility and narcotism, with relaxation of the muscular system. At first the patient is conscious of all that is passing around him, but there is dizziness and singing in the ears. Then the mental functions are impaired, there is often excitement, the saliva is increased, the patient pushes away the inhaler, rigidity and spasms of the muscles may occur, and there is incoherent talk. In the next stage there is insensibility to pain, and the conjunctiva may be touched without causing flinching. If the use of this anesthetic be pushed further, the breathing becomes stertorous, the muscles quite relaxed, and the pupils dilated; while a still further increase of the chloroform embarrasses and then stops the breathing and arrests the heart's action.

Many cases of death from the vapor of chloroform have occurred, the fatal effect sometimes happening very rapidly from shock, syncope, or convulsions; in others, again, by way of asphyxia. The vapor of only **thirty drops**

has destroyed life in one minute. In an untried case, as the effects of chloroform can never be predicated, extreme caution should always be observed. Death **under** the influence of chloroform must not be confounded with death **from** its effects. The smallest fatal dose when the drug has been swallowed is **one dram** in a boy aged four.

The effects of chloroform taken by the mouth are of the same description as those which follow the inhalation of this agent; with this exception, that the fatal result seems to be longer deferred. A case reported in the "Medical Times and Gazette," 10th May, 1862, illustrates the symptoms, etc., in a clear way. Mr. M., thirty-four years of age, a highly gifted, restless man, was in the habit of inhaling chloroform. At about 12.30 a. m., the gentleman drank some chloroform; the quantity being uncertain, though it was inferred to be about one ounce. At 7.15 he was in such profound sleep that his wife felt uneasy, and sent for a physician, who found the patient in a tranquil sleep, the respiration being somewhat hurried and audible, the pulse full but slow, the body warm, and the pupils dilated and insensible. There was a perceptible smell of chloroform in the breath and in the air of the room. The window was opened, ice was applied to the head, cold affusions were used along the spine, and an enema was administered. At 9.30 the patient was paler, breathing less audibly, and with a weaker pulse. Artificial respiration was employed, an ammo-

nia lavement was given, and iced water to the chest and pit of the stomach was used alternately with warm coverings. The stupor continued, the abdomen became tympanitic, and the pupils began to contract. About 9 p. m. the eyes began to move, the pupils seemed sensible to light, the pulse was 160, there was abundant perspiration, and the patient sat up for a few moments and looked surprised. Exhaustion, however, set in, and death occurred just before midnight, nearly twenty-four hours after swallowing the poison.

In a second case a gentleman, fifty years of age, swalowed two ounces of pure chloroform at 8 a. m. He was not seen until 3 p. m., when he was found in a state of deep coma. His breath smelt strongly of chloroform, the pupils were widely dilated and insensible, the pulse slow and feeble, the surface colder than natural, the movements of the thorax scarcely perceptible, and sensation generally abolished. Ammonia sinapisms, bottles of hot water, and cold affusion, did no good; but on using a stomach-pump a quantity of chloroform mixed with watery mucus was withdrawn, and in less than an hour the patient was able to answer questions. For three or four days he complained of a burning sensation in the throat and epigastrium, and then got well. A consideration of the treatment employed in this instance suggests the idea that the first patient might have had a better chance of recovery had the stomach-pump been used at *once.*

In the TREATMENT of poisoning by the vapor of any of the anesthetics mentioned in this chapter, we must **expose the patient to a current of pure air,** use **cold affusion,** and employ **artificial respiration** until the poison is eliminated. **Galvanism** may be employed to keep up the action of the diaphragm, either directly or through the phrenics. Inversion of the body has occasionally been resorted to with success. As these agents are got rid of through the lungs, the purity of the expired air is one test of the elimination being complete, though of course inferior to the evidence afforded by the subsidence of the symptoms. In poisoning by liquid chloroform or ether, the stomach-pump ought to be promptly used.

TEST.—Chloroform at a red heat is decomposed, and chlorin and hydrochloric acid are formed. Hence, to detect it, the substance supposed to contain the chloroform may be heated (by means of a water-bath) in a retort or other vessel, so as to expel the chloroform, which should be conducted away from the heated vessel by a tube bent at right angles. To this tube heat should be applied to decompose the vapor, and the products searched for by the ordinary tests. If these products be conducted into a solution of silver nitrate the white **silver chlorid** will be formed. The **hydrochloric acid,** which also escapes, will redden litmus paper; and the **chlorin** will bleach litmus paper, and set free iodin from potassium iodid, and so **blue** a paper coated with a so-

lution of **potassium iodid in starch.** The smell is a valuable criterion.

CHLORAL HYDRATE, which with an alkali is converted into chloroform, has been much used as a narcotic and for relieving pain, unfortunately also by the public, to many of whom its use has become almost a necessity. It does not produce the nausea and headache which follow the use of opium. It is a frequent ingredient of so-called "knock-out drops" used for drugging liquor to assist in the commission of robbery or rape. It is hardly possible to give the dose required to cause death, since there is much difference in the susceptibility to its effects. In one case 30 grains is said to have done so. When the substance has been taken in one dose it has often happened at night, and the patient has been dead in bed in the morning. When the smptoms have been observed there has usually been some excitement, with delirium, followed by profound unconsciousness, stertorous breathing, gradually becoming more and more feeble, lividity and pulselessness. The period of death is uncertain.

TREATMENT.—This should be strenuously directed to keeping up artificial respiration, for hours, if necessary. The stomach-pump should be used if in time, and it is difficult to say when it is too late. Emetics of mustard and other stimulant substances, **except** ammonia, may be freely used.

ETHER.—Ether, often wrongly called sulph*uric ether, is a* clear colorless liquid, very in-

flammable, soluble in alcohol, and less so in water. It is usually obtained by distilling common alcohol with sulphuric acid.

The effects produced by the inhalation of ether are very similar to those which result from chloroform. It is, however, without doubt, a much safer agent, but its effects are longer in manifesting themselves; it is more irritating to the air-passages and the salivary glands, and often gives rise to troublesome bronchitis, and much more of it is required. Deaths have occurred under its influence, as that of chloroform, though far less frequently.

NITROUS OXID produces a brief anesthesia, hence is chiefly employed in dental operations and minor surgery. It has, however, been given for a considerable length of time consecutively, by allowing the patient to return to the verge of sensibility before giving a fresh dose.

CHAPTER XXVII.

INEBRIANTS.

NEUROTICS ACTING ON THE BRAIN AND PRODUCING INTOXICATION.

ALCOHOL.—NITROBENZENE.—COCCULUS INDICUS.—FUNGI, ETC.

ALCOHOL.—Spirituous liquors, when taken in large quantities, not unfrequently produce fatal effects.

Two wineglassfuls of brandy proved fatal to a boy seven years old in thirty hours. Dr.

action of the refined article may be due to so unrecognized tar-product. The use of meth alcohol in tinctures (e. g. iodin, witchhaze liniments (soap liniment), barbers' wash (bay rum), must be borne in mind, since ev inhalation of the vapor will in time produ the typical blindness.

FORMALDEHYDE.—This is a derivative methyl alcohol. Its action as a poison is d scribed on page 74.

NITROBENZENE and ANILIN.—A co pound, made from the rectified products coal-tar and nitric acid, and known as nitr **benzene,** also called nitro-benzol, is sometim used as a substitute for essential oil almonds. It is sold to perfumers under t name of "essence of myrbane." The effec of this substance do not usually show thei selves for about two hours, and therein lies valuable point of distinction between it a the essential oil of almonds, the effects which (due to prussic acid) come on immed ately. Death results by coma. The odor the breath is highly characteristic. The su stance is very insoluble in water, hence t use of the stomach-pump promises well if u dertaken soon after swallowing.

A lad employed in some chemical work finding a syphon did not act, sucked throug it some of the fluid, which happened to be n trobenzene. No immediate effect resulted, b *in a few* hours he felt as if he were drun *Stupor came on* and ended in death twe *hours after swallowing* the poison.

TEST.—To distinguish nitrobenzene from essence of almond, a drop of sulphuric acid may be used; this reddens the almond essence, but does not affect the nitrobenzene.

Another product of the destructive distillation of coal in gas-making is **anilin,** a colorless, limpid, acrid and poisonous liquid. It has given rise to very alarming symptoms when swallowed, as well as when inhaled in vapor. It produces a remarkable **blue** or **purple** discoloration of the body, particularly **the lips** and **nails.** Cases of poisoning from inhalation of anilin vapor used in shoe-polish have been reported.

COCCULUS INDICUS.—The kernel of the berry of the **Menispermum cocculus,** or Levant nut, imported from the East Indies, contains from one to two per cent. of a poisonous principle named **picrotoxin.** Thieves sometimes mix a decoction or extract of the berries with spirits or beer, to give these drinks an intoxicating property (hocussing). Dishonest publicans, too, first reduce their beer by means of salt and water, and afterwards give it intoxicating properties by adding cocculus extract. The same substance is used by poachers to destroy fish. The symptoms produced appear to be, in some cases, vomiting and purging, a peculiar stupor, a complete loss of voluntary power, with a consciousness of passing events. In some cases there are convulsions, and an eruption like that of scarlatina has been observed.

DARNEL SEEDS (Lolium temulentum).—The seeds of this plant, which is often found growing with corn crops, when accidentally mixed in considerable quantity with wheat or rye, and ground into flour, have caused gastric pain, severe giddiness, vomiting, and other symptoms of intoxication. The sufferers complained that everything seemed of a green color. A wet season is said to encourage the growth of darnel with the varieties of corn.

CAMPHOR.—This substance is very variable in its action. It has given rise to alarming symptoms on some occasions, and once it has destroyed life. In scruple and half-dram doses, it has produced giddiness, difficulty in walking, dimness of sight, difficulty of breathing, delirium, and insensibility.

TREATMENT.—In the case of all these substances the stomach-pump or emetics must be employed. If the effects are not very severe they will generally cease spontaneously after a time.

FUNGI.—The type of the class of poisonous fungi may be taken as the **Amanita muscaria.** This is an autumn fungus of an orange-red color, and is used among the Siberian tribes, especially the Koraks, as an intoxicating agent, and produces symptoms somewhat similar to those of alcohol.

The **Agaricus campestris** and **A. esculentus** are the fungi most frequently used as articles *of food, but* even these are indigestible. They

occasionally produce diarrhea, with a pruriginous or exanthematous rash in dyspeptics; and should only be eaten in great moderation.

There are no very positive characters except those afforded by an accurate botanical knowledge, whereby the wholesome fungi may be distinguished from the unwholesome. By careful treatment even those usually unwholesome may be safely eaten. Moreover those which may be eaten with impunity by some individuals prove destructive to others. Thus, a French officer and his wife died from breakfasting off mushrooms which others in the house ate without inconvenience. As a general rule highly colored mushrooms, with an astringent, styptic taste, a forbidding pungent odor, and which grow in dark and shady places, should be avoided.

The symptoms produced by poisonous fungi are usually those indicative of gastro-intestinal catarrh, with a disordered condition of the nervous system, and considerable depression; but, again, they may act much more like pure narcotics.

In treating these cases, the stomach and intestines must be thoroughly emptied, and the prominent symptoms are to be relieved according to their urgency.

CHAPTER XXVIII.

DELIRIANTS.

NEUROTICS ACTING ON THE BRAIN AND PRODUCING DELIRIUM.

BELLADONNA—STRAMONIUM—DHATOORA—HYOSCYAMUS—NIGHTSHADE—COCAIN.

ATROPA BELLADONNA (Deadly Nightshade).—The Deadly Nightshade is indigenous, and grows in woods and gardens. The roots, leaves, and berries are poisonous, this property being due to the presence of an alkaloid called **Atropin.**

SYMPTOMS.—Poisoning by Belladonna or its alkaloid: **Dryness of the mouth and throat with thirst** which nothing allays, **nausea** and **vomiting,** great **dilatation** of the **pupils, indistinct and double vision, giddiness,** palpitation of the heart, physical and mental depression, perversion of the sense of taste, and **delirium** followed by **stupor,** form the chief symptoms. They may set in within from half an hour to three or four hours of swallowing the poison. Death has followed **in two hours and three quarters** after swallowing **a dram** of the extract. Sometimes **the face is red and swollen** and **a scarlatinal kind of rash** upon the skin, a disposition to **laugh and talk wildly, fanciful delusions,** a rapid flow of ideas, and difficulty in walking have been observed. There is often also a desire, without the ability, to pass *water. Muscular* twitchings, especially of the

legs, are not unusual, and death may be brought about by **convulsions.**

A large detachment of French soldiers, halting near Dresden, ate freely of the belladonna berries. Shortly afterwards they were seized with nausea, thirst, dryness of the throat, difficult deglutition, insensibility of the eye, great dilatation of the pupil, delirium and coma.

POST-MORTEM APPEARANCES.—Congestion of the cerebral vessels and lungs, dilated pupils, red patches at different parts of the alimentary canal, and a (dyed) purple hue of the gastric mucous membrane, if the berries have been eaten, are the most common appearances.

TREATMENT.—The stomach-pump, **stimulant emetics, castor oil,** and animal charcoal are the remedies to trust to. In a certain number of cases opium has seemed to act as a physiological antidote to belladonna, but this is not to be relied upon, though it may be found useful.

ATROPIN.—Atropin by way of subcutaneous injection has often produced serious symptoms, and in one case where a young man took two grains of **atropin** on going to bed, he was heard to snore heavily during the night, and was found dead at seven o'clock in the morning. No trace of poison was found on analysis. Its solution (one gr. to the ounce of water) is much used as a mydriatic, a drop or two being inserted into the eye. Even this requires caution.

TEST.—There is no very certain test for **Atropin** beyond its effects on the pupils and on vision, which may be produced by the substance if recovered from the viscera.

STRAMONIUM (Datura Stramonium, Thorn-Apple) is indigenous in Great Britain, but is found almost everywhere, growing on the commons. The fruit and seeds are the most poisonous parts of the plant. The active principle, an alkaloid, named **Daturin,** has properties identical with those of Atropin.

The poisonous effects of stramonium are the same as those of belladonna, and are to be relieved by similar remedies. When this drug is prescribed as a medicine, as it often is for spasm of the bronchial tubes, it should be immediately discontinued if it produces dryness of the throat and dilatation of the pupils.

DHATOORA.—In India the seeds of the Datura alba, a plant which grows abundantly in most parts of that country, are frequently used for the purpose of hocussing travellers, in order that they may be robbed with impunity. The seeds, which closely resemble those of the capsicum, are mixed with food, and give rise to total insensibility, often with noisy delirium or delusions. Death is not infrequent after a large dose, although it would seldom seem to be administered for murderous purposes, but rather to procure the state of insensibility favorable to the committing of robbery. Its effect may be for the time being to completely *alter* the disposition of the individual, and to

cause him to give way to all kinds of foolish notions and antics.

HENBANE (Hyoscyamus niger).—All parts of this plant are poisonous; but the seeds are more powerful than the roots or leaves. In medicinal doses it is a feeble narcotic. It owes its power to an alkaloid **(hyoscyamin).**

In very large doses henbane produces **giddiness,** flushings, excitement, and a sense of weight in the head; the limbs tremble, and there is general loss of power; the **pupils** become **dilated,** there is **double vision, presbyopia,** flashing of light before the eyes, and great drowsiness, ending in **coma.** If vomiting supervene, these symptoms generally pass off; otherwise we may find fierce **delirium,** loss of speech, complete loss of power over the limbs, cold sweats, and exhaustion.

In some instances, when the roots have been eaten by mistake for parsnips, the symptoms have been those of drunkenness and delirium. This error, it is said, was committed one night at a monastery. The monks who partook of the roots had such hallucinations that the establishment resembled a lunatic asylum. They rang the bell for matins at midnight; and those who attended were unable to read, or they read that which was not in the book. In another case the roots were put into soup, of which nine persons partook. Although no unpleasant flavor was noticed at the time of eating, yet very shortly afterwards all complained of an acrid taste, nausea, indistinctness of vision, restlessness, delirium, and great somnol-

ency, which continued some time. Hyoscyamus has seldom if ever proved fatal.

TREATMENT.—To prevent a fatal result from the use of henbane or others of this group, we must trust to the **stomach-pump, stimulant emetics,** as **sulphate of zinc,** and full doses of **castor-oil,** so as to get rid of the offending substance.

TEST.—The only test for hyoscyamus is the botanical characters of the plant, when taken in substance, and its power (common to all in this group) of dilating the pupil.

NIGHTSHADE.—The **Solanum dulcamara** (Bitter-sweet, or Woody Nightshade) and the **Solanum nigrum** (Garden Nightshade) contain an active principle known as Solanin. The red berries of the first named plant, and the black berries of the second, have been eaten by mistake. They give rise to thirst, headache, giddiness, dizziness of vision, dilated pupils, convulsions, vomiting, and purging. They may even cause death.

COCAIN.—This substance may be appropriately considered under the present head. It is a crystalline alkaloid, found in the leaves of the **Erythroxylon Coca,** a shrub of South America. It is colorless; has a bitter taste; is nearly insoluble in water and alcohol; soluble in ether; basic in its chemical relations.

In small doses it is a cerebral, cardiac, respiratory and nervous stimulant. Overdoses *produce* great embarrassment of the heart and

lungs, the pulse becoming small, rapid and intermittent. Respiration slow and feeble. Death occurs from spasm of the heart and muscles of respiration. It also occasions delirium and hallucinations, and likewise dilates the pupils; whether taken internally or applied externally. Dose, ¼ of a grain. It is usually taken to correct the **morphin habit;** but is very apt to substitute its own habit upon the unfortunate patient.

Cocain is valuable as a local anesthetic, in from 4 to 10 per cent. solutions, as an application to painful affections of the nose, ear and throat; also in minor surgical operations. This local application sometimes produces dangerous symptoms. Five grains taken internally have occasioned dangerous symptoms; although death is a rare result there is no proper antidote: morphin is perhaps the best physiological remedy. Cocain resembles atropin in its general action, especially in its influence on the pulse, respiration, pupils, sweat glands and bowels.

What is termed the **cocain habit** is marked by insomnia, loss of digestive power, enfeeblement of mind, emaciation, hallucinations, delirium and general loss of health—a condition much resembling the worst effects of opium.

Solution of cocain, and of an analogous alkaloid **eucain,** are now much used as local anesthetics for teeth extraction.

CHAPTER XXIX.

CONVULSANTS.

NEUROTICS PRODUCING CONVULSIONS.

NUX VOMICA—STRYCHNIN—BRUCIN.

THE chief plants which yield the alkaloid Strychnin are the **Strychnos nux vomica; and** the **Strychnos Ignatii.** The effects of the active principles yielded by these plants are exerted chiefly upon the spinal cord. This is shown by the violent convulsions and the tetanic contractions of the muscles which they produce. They have no effect on the brain, consciousness remaining intact until death.

NUX VOMICA.—Thirty grains of the powder have proved fatal, in one somewhat doubtful case. Nux vomica is seldom if ever used nowadays as a powder, and it is not easy to say what would be the smallest fatal dose—half an ounce has destroyed life in well-recorded instances, and so have **three grains** of the alcoholic extract. Death may occur in from **fifteen minutes to twelve hours.** It is possible that nux vomica may accumulate in the system, as serious symptoms have arisen from the long-continued use of small doses. Thus a lady took nine grains of the powder daily, in divided doses, for sixteen days. As purging then set in with colic, the medicine was withdrawn. Five days after the withdrawal there was ringing in the ears, with drowsiness, impairment of speech, etc.; on the ninth day

tetanic symptoms set in, with trismus; and on the twelfth day, after several tetanic convulsions, death took place from exhaustion.

BRUCIN.—Nux vomica yields both strychnin and brucin; the latter when pure does not resemble strychnin physiologically.

STRYCHNIN.—This alkaloid is the active ingredient of some preparation sold for destroying vermin: "Battle's Vermin Killer" consists of flour, Prussian blue, sugar, and strychnin in the proportion of twenty-three per cent.

One sixteenth of a grain of strychnin has caused the death, in four hours, of a child between two and three years of age. **Half a grain** of **sulphate** has proved fatal, and death occurred in **twenty minutes;** but death has occurred in five minutes, and in ten. The symptoms come on almost **immediately,** but may be deferred for **three hours,** though usually all danger is over in two hours. A woman twenty-two years of age died in the Jersey Hospital from the accidental administration of half a grain.

SYMPTOMS.—The time at which the symptoms commence varies according as the strychnin has been taken in solution or in the solid form. In the former case a very **bitter taste** is experienced during swallowing, usually followed in a few minutes by a sense of **suffocation** and **difficulty of breathing.** Soon there follow **stiffness about the neck** and **sense of impending death, twitching of the muscles, jerking movements of the lower limbs especial-**

ly, and a **quivering of the whole frame.** The limbs become rigid, the head is bent **back,** while the body is **stiffened and arched,** so that it rests on the head and heels (opisthotonos). The difficulty of breathing causes the face to become **dusky,** the eyeballs prominent, and the lips livid, whilst the feature assume a peculiar grin **(risus sardonicus).** There is much thirst, but **inability to drink from spasms of the jaws;** the sufferer is **quite conscious,** is much alarmed, and is impressed with the idea that death is surely stealing upon him. As the attacks of spasms begin, the patient cries out, and warns those about him of the approach of the seizure; he begs for help, and perhaps asks to be held, or rubbed, or turned over; and when the seizure passes off, at the end of forty or sixty seconds, he is exhausted, and bathed in sweat. The more he is disturbed or excited, the shorter is the interval between the attacks; and though a firm grasp seems to afford relief, yet a slight touch, a gust of air, or the opening of a door, will bring on a fresh attack and increase the suffering. As death approaches the tetanic spasms rapidly succeed each other, and the patient sinks **suffocated** during an attack, or **exhausted** during an interval, in about two hours from the beginning of the symptoms.

There is commonly a wide difference between tetanus arising from a wound or from disease, and that provoked by strychnin. In the former case some exciting cause can be detected; the symptoms come on gradually, and only attain their full development at the end of *several* hours; the rigidity of the muscles is

more or less permanent, there being no intervals of relaxation as there are in poisoning by strychnin; and death has hardly been known to occur in less than twenty-four hours; most frequently it is deferred for two or three days.

POST-MORTEM APPEARANCES.—Although the body may be relaxed at the time of death, it usually quickly stiffens—frequently in the course of ten or fifteen minutes. The rigor mortis is persistent for some time; in the case of Cook, poisoned by Palmer, the rigidity of the body and limbs was said not to have passed off after two months' interment. This is not, however, invariable, as a body may be flaccid or stiff after death from this cause as from any other. The hands are often clenched, and the soles of the feet are arched and inverted. The membranes of the brain and of the upper part of the spinal cord are congested; and there is often considerable serous effusion under the spinal arachnoid. The lungs are generally loaded with dark fluid blood. The heart is usually contracted, but sometimes the right cavities are distended, like the pulmonary vessels, with black and liquid blood.

TREATMENT.—Emetics are to be given at once, and repeated until very free vomiting is induced. If the tetanic spasms have not commenced, the stomach pump ought to be used. Chloroform is to be given to relieve spasm and pain, but the patient should be disturbed as little as possible, inasmuch as the least thing induces the tetanic attack.

There is no very suitable antidote. The chief reliance is to be placed on chloroform

carefully administered, combined with chloral hydrate and potassium bromid.

The patient is above all **to be kept warm and quiet.**

To separate styrchnin from organic mixture, the process given in the beginning of this book is the most useful.

TEST.—Strychnin is a white crystalline solid, very insoluble in water, soluble in alcohol or chloroform or weak acids, and having an intensely bitter taste.

2. Strychnin, when dissolved in **sulphuric acid,** gives rise to no change; but on adding a fragment of **potassium dichromate** to the solution, a series of **blue, violet, purple and red tints are produced.** The same result is brought about by using **potassium ferricyanid, potassium permanganate,** the **lead dioxid, manganese dioxid,** and similar oxidizing bodies.

3. If the skin of a **frog** be dried, and a few drops of a solution containing strychnin applied to it, **strong tetanic convulsions** will ensue, and be reproduced every time the animal is touched or irritated. According to Dr. Marshall Hall, this strychnoscopic test will detect the one five-thousandth of a grain, or even less.

This test is now unlawful in Great Britain without a judge's order.

4. An exceedingly useful class of tests for many poisons has been introduced by Dr. Guy; these are the **crystalline appearances** presented on subliming the substance and condensing it on a cool microscope slide, or the crystalline *forms observed* as modified by various reagents.

Thus the strychnin sublimate, touched with a drop of picric acid, forms groups of arborescent crystals, each branch forming part of a circle.

BRUCIN, whilst not responding to these color tests, is **reddened** by **nitric acid,** but it does not decompose iodic acid, and may thus be distinguished from morphin. Brucin was formerly supposed to be analogous to strychnin, but this was due to the fact that commercial brucin generally contains some strychnin.

CHAPTER XXX.

PARALYSANTS.

NEUROTICS PRODUCING PARALYSIS OF THE MOTOR NERVES.

CURARE—CALABAR BEAN.

THOUGH paralysis of the voluntary muscles is a frequent symptom of poisoning by neurotic agents, yet there are several whose most marked effect is this muscular paralysis. The type of these poisons is **Curare.** This substance has been imported in various forms—first on arrow points, latterly in shape of extract. It has been largely used in physiological investigation. It has little effect when swallowed, being chiefly active when introduced beneath the skin. Its effects are **complete muscular paralysis,** as far as the voluntary system of muscles is concerned, with slowing of the **heart's action** and **diminished respiration,** until gradually life becomes extinct. It is said that no

affection of the sensory nerves results from its use; and it is quite certain that prolonged artificial respiration may tide an animal over its effects. Curare has been proposed as a remedy for hydrophobia, and one case is recorded where its persistent employment, and the use of artificial respiration, is said to have succeeded in saving the patient's life.

Tobacco, antimony, and other substances have been used to produce muscular relaxation before the introduction of chloroform, but none of them seem to act in exactly the same way as curare.

In the case of such substances as chloroform, both the sensory and motor nerves are paralyzed: that is to say, it is both an anesthetic and paralysant. But the anesthesia comes first, and it may be used as a pure anesthetic, without interfering with motor power.

CALABAR BEAN (Physostigma venenosum).—This bean, which grows on the West Coast of Africa, is on that coast used as an ordeal. According to the notions of the natives, the innocent vomit and are safe, the guilty die. Its most characteristic effect is contraction of the pupil. It seems to act by paralyzing the motor muscles, leaving the senses intact. There is a great interference with the heart's action, it beating tumultuously, but death seems to follow paralysis of the muscles of respiration. In some cases, one fatal, occurring in Liverpool, there was much vomiting. *The active principle* is named **eserin.**

CONIUM (Conium maculatum, Common or Spotted Hemlock).—The seeds, leaves, and roots of the **Conium macultum** are all poisonous. The effects are rather variable, sometimes consisting chiefly of delirium, stupor, coma, and convulsions; on other occasions, the action, being chiefly exerted on the spinal cord, gives rise to **gradually extending paralysis,** the lower limbs being first affected, afterwards the arms and chest, thus producing death by apnea from **paralysis** of the **muscles of respiration.** Probably, however, could artificial respiration be kept up, the heart would continue to beat much longer.

The alkaloid of hemlock is a pale yellow, volatile, acrid, oily looking liquid, knows as **conin.** It is a potent poison, occasioning general paralysis without loss of sensibility. This alkaloid, which is found in all parts of the plant, may be readily recognized by rubbing with caustic potassa. This sets free the alkaloid from its combination, and being readily volatile, its mouse-like odor becomes at once apparent. Chemically it is allied to ammonia, and gives many of the reactions of that substance.

Conium has considerable historic interest as it is believed to be the poison with which Socrates was put to death.

CHAPTER XXXI.

HYPOSTHENISANTS, OR SYNCOPANTS.

NEUROTICS PRODUCING DEATH BY SYNCOPE.

ACONITE—PRUSSIC ACID—GELSEMIUM.

ACONITE (Aconitum Napellus, Monkshood, Wolfsbane, Blue Rocket), of which **aconitin** is the alkaloid, is probably the most deadly poison known; the fiftieth part of a grain of the alkaloid having nearly caused death.

The chief **symptoms** of poisoning by aconite are **heat, numbness** and **tingling** in the mouth and throat, **giddiness, abolition of muscular power,** pain in the abdomen, with vomiting and purging. Sometimes delirium and slight stupor have been noticed. The **pupils are usually dilated,** the **skin is cold,** the **pulse exceedingly feeble,** the breathing oppressed, and there is a dread of approaching death. The sufferer is **perfectly conscious,** though **numb and paralyzed,** till death suddenly occurs after two or three hurried gasps. Death may be due to what might almost be called **shock,** or **sudden** and **complete collapse,** or to **asphyxia** from paralysis of the respiratory muscles.

A fatal mistake has been made in eating the root of aconite for that of horseradish, but the sense of tingling and numbness produced by the former is so different from the pungent *taste* of the latter, that no mistake should occur.

A case occurred in Ireland where a woman poisoned one man and nearly killed another by sprinkling powdered aconite root over a dish of greens.

Of the root, one dram, of the tincture, one ounce, and of the alcoholic extract, four grains, have caused death. Death follows a considerable dose in less than an hour, but sometimes a longer period elapses.

The Bikh or Bish poison, formerly much used in India, and still not unfrequently employed, has as its basis the Aconitum ferox, a still more dangerous drug than our indigenous plant.

TREATMENT.—No time must be lost in the use of remedies. In addition to emetics, or the stomach-pump, castor oil, and animal charcoal, benefit may be derived from administering strong coffee. Brandy or ammonia should also be given, while the limbs and back are well rubbed with hot towels. Artificial respiration should not be forgotten.

There is no good test for aconitin. In a case of poisoning, reliance must be placed on the peculiar tingling taste of the ultimate extract, and on the effect of this latter on some small living animal.

HYDROGEN CYANID (Prussic Acid), on account of its energetic and rapid action, is one of the most formidable poisons with which we are acquainted. In its concentrated state (which is scarcely even seen except in the laboratory), it is limpid, colorless liquid, possess-

ing a somewhat acrid taste, and having an odor, when diffused through the air, resembling that of oil of bitter almonds. When diluted with water, it forms the acid kept by the druggist. The properties of this variety are similar to those of the pure form, except that if kept in the dark, it is not so readily decomposed. It is in this condition that it is used as a poison. The diluted acid of the Pharmacopei contains about 2 per cent., and that known as Scheele's from 4 to 5 per cent., of the strong acid; but all vary greatly with the keeping.

One of the derivatives, POTASSIUM CYANID, claims a short notice, since it is largely employed by photographers, workers in electrotypy, and in some mining operations. It has often been taken as a poison. The salt is sold in the form of deliquescent white crystals, or in crystalline masses, which are very soluble in water, and possess the odor of prussic acid. From three to five grains will destroy life almost as rapidly as prussic acid itself, and in the same manner. A dose of five grains has proved fatal.

Several vegetable substances yield prussic acid, such as the kernels of the peach, apricot, nectarine, cherry, etc., the leaves of the cherry laurel and the pips of apples and pears. Cases of alarming illness have occurred from eating **bitter almonds** or peach kernels too freely; while the essential oil obtained by distilling *the pulp* of these almonds with water is a *powerful poison.* This **essence** or **oil of bitter**

almonds contains about 10 per cent. of anhydrous prussic acid; and it is probable that from ten to thirty drops would prove fatal to an adult. The prussic acid may, however, be separated from it, and leave the oil harmless.

A distilled water obtained from the **Leaves of the Cherry Laurel,** which was formerly employed in medicine, proved dangerous from its very variable strength; it has been used as a poison. In the well-known case of Sir Theodosius Boughton, poisoned by Captain Donellan in 1781, **laurel water** produced death within half an hour after two ounces had been swallowed.

The smallest quantity of prussic acid which has been known to destroy life is nine tenths of a grain of the anhydrous acid, equal to **forty-five minims** of the diluted preparation of the Pharmacopeia; and it is probable that this would, in most instances, prove fatal. In the case referred to death occurred in twenty minutes; but from a larger dose it has ensued much earlier. The period may be said to vary from two to five, and even forty minutes. Insensibility may, however, come on in a few seconds. In the case of seven epileptics accidentally poisoned at the Bicetre, death occurred in the first within twenty minutes, in the last after three quarters of an hour, though the dose of the acid was the same in each instance.

SYMPTOMS.—These will vary with the dose and the mode of exhibition. Inhalation of the vapor of anhydrous prussic acid would immediately cause death. The vapor of the diluted

acid has given rise to serious symptoms with great rapidity. Scheele is said to have been suddenly killed by respiring the vapors of the dilute acid while making his experiment.

When the diluted acid is taken in a large dose the symptoms may commence during swallowing, death following so quickly that scarcely any effects can be observed. The chief symptoms, perhaps, are insensibility, loss of muscular power, slow gasping, or convulsive respiration, a clammy cold skin, fixed and glistening eyes, dilated pupils, spasmodic closure of the jaws, an almost imperceptible pulse, and sometimes convulsions of the limbs and trunk. The rapidity with which consciousness may be lost is well exemplified in an instance recorded by Hufeland, where a man about to be apprehended as a thief took an ounce of the acid, staggered a few steps and fell apparently lifeless. In a few moments a single violent inspiration was made, and within five minutes of taking the poison he was dead.

Insensibility is not, however, in all instances, immediately produced; many an authenticated case having occurred in which the symptoms were protracted for some minutes, the individual performing several acts indicating consciousness, such as replacing the cork in the bottle, adjusting the bedclothes, or even running some distance to summon help.

A small dose produces faintness, insensibility, difficulty of breathing, involuntary evacuations, loss of muscular power, convulsions, *and temporary paralysis*. If the proper treat-

ment be employed, recovery may often be effected.

POST-MORTEM APPEARANCES.—The body is generally livid, the countenance pallid, or sometimes livid and bloated, the jaws firmly closed, and the hands clenched. There is frequently blood or froth about the mouth, and the eyes are sometimes described as prominent and glistening. There is often an odor of prussic acid about the body, which is more perceptible on opening the stomach. The venous system is usually gorged with blood; and the brain, lungs, heart, liver, spleen, and kidneys have been found congested with dark-colored fluid blood.

In poisoning by potassium cyanid irritation of stomach and esophagus may occur as the commercial cyanid often contains potassium carbonate and hydroxid.

TREATMENT.—There is no chemical antidote to this poison which can be relied upon. A mixture of ferrous sulphate and sodium carbonate has been recommended; it produces insoluble Prussian blue. Hydrogen dioxid is antidotal, but is not practically applicable. **Ammonia** has been recommended. Attempts must be made to restore animation by cold affusion, stimulating frictions to the chest and abdomen, warmth to the surface, and the application of ammonia to the nostrils. **Cold affusion over the head and neck** has proved most efficacious when promptly restorted to and repeated at short intervals so as to cause a shock. Cobalt compounds have antidotal value

but could only be given in doses of a few grains in much water.

If recovery ensues from the immediate effects, vomiting should be produced by emetics or otherwise; after which strong coffee, with brandy, ought to be administered.

TESTS.—The best are the following:

When **hydrocyanic acid** has to be separated from organic substances, such as **the contents of the stomach,** it is usual to take advantage of its ready volatility. If the acid be not in combination, it may be given off so readily as to be detected by a watch-glass moistened on its under surface with a drop or two of a solution of silver nitrate held over the vessel containing the acid; this will speedily become white; but in order to make sure of its presence or absence, the following process should be adopted:

1. The suspected material should be acidulated with pure sulphuric acid so as to insure the prussic acid being in a free state.

2. The substances thus acidulated are to be placed in a retort.

3. Distilled over a water-bath; and

4. The distillate collected in a cool receiver **containing some caustic potassa.** About one sixth of the fluid substance should in this way be distilled over; when

5. The liquid in the receiver may be tested by the silver and iron tests, or the vapor as it *passes over may* be tried with the sulphur test.

The peculiar odor of prussic acid is well known, and is a very delicate test, taken in conjunction with others, of its presence.

(a) THE SILVER TEST.—**Silver nitrate** yields, with hydrogen cyanid or potassium cyanid, a **white clotted precipitate** (silver cyanid), insoluble in cold, but soluble in boiling nitric acid. If this precipitate be well dried and heated in a small glass tube, drawn out to a point, cyanogen will be given off, which may be known by its burning with a purplish flame. This test is very delicate.

(b) THE IRON TEST.—Of the liquid collected in the receiver above mentioned, or of the suspected acid liquid, carefully neutralized by caustic potassa, a portion is to be taken, and to this is to be added a small quantity of mixed solution of **ferrous and ferric sulphate.** A **dirty brownish or greenish precipitate** will fall, consisting of a mixture of the oxid of iron and Prussian blue. On adding a few drops of **dilute sulphuric** or **hydrochloric acid,** and thus dissolving the oxids, the intense color of **Prussian blue** will immediately be made clear should hydrocyanic acid be present.

(c) THE SULPHUR TEST.—One of the most useful tests for prussic acid, whether in the fluid or volatile state, is the so-called **sulphur** or **Liebig's test.** It is best adapted for detecting the acid in a state of vapor, and to this end a drop of **yellow ammonium sulphid** in a watch-glass is held inverted over the suspected liquid, which may be warmed by the hand to facilitate the evolution of the acid. In

this position the watch-glass should be allowed to remain for some little time, till it has nearly dried, after which a drop of a neutral solution of sulphate or chlorid of iron is to be added, which will give rise to a **blood-red color** completely **discharged** by **corrosive sublimate.** The color produced by ferric salts with **meconic acid** is **not** so **discharged** by corrosive sublimate, or gold chlorid.

If the acid is in the liquid form, a drop of the prussic acid and one of the yellow ammonium sulphid may be mixed and heated until they thoroughly combine to form ammonium sulphocyanate. A drop of ferrous sulphate is then added as before, but all the sulphid must have been previously decomposed by heat, otherwise black ferrous sulphid will be produced (even though prussic acid be present), instead of ordinary blood-red color.

(d) THE COPPER TEST.—**Copper sulphate** added to prussic acid rendered slightly alkaline by potassa gives a **greenish-white precipitate,** which becomes **white** by the addition of a few drops of **hydrochloric acid** to dissolve the blue precipitated copper oxid.

GELSEMIUM. From the rhizoma of the **Gelsemium sempervirens,** a climbing plant of the southern United States. It contains an alkaloid, **gelsemin** (the active principle) and **gelsemic acid.** The fluid extract is the preparation generally used. Dose, 5 drops, carefully watched. It is a powerful motor-depressant, *causing* paralysis of motion and loss of sensibility *by its central* action on the spinal cord.

It is also antispasmodic and diaphoretic, and a depressor of the heart. Poisonous doses produce vertigo, drooped eyelids, double vision, dilated pupils, labored respiration, dropped jaw, extreme weakness, slow and feeble heart, complete anesthesia, profuse diaphoresis, loss of speech, staggering gait, and death by asphyxia from paralysis of the muscles of respiration. Fatal dose may be fixed as a teaspoonful of the fluid extract. No chemical antidote is known. Morphin is probably the most reliable remedy.

CHAPTER XXXII.

DEPRESSANTS.

NEUROTICS PRODUCING MARKED DEPRESSION OF THE HEART'S ACTION.

DIGITALIS—TOBACCO—LOBELIA—COLCHICUM—VERATRIA.

DIGITALIS PURPUREA (Purple Foxglove).—The seeds, leaves, and root of this indigenous hedge-plant are poisonous. Digitalin is a principle which these parts contain.

Digitalis is very uncertain in its action. When given medicinally its effects should be watched, as in some cases it is said to accumulate in the system, but in others, especially in heart disease, it may be given for months or years without hurt, and even with advantage. A poisonous dose seems to produce vomiting, purging, colic, headache, great slow-

ness and extreme irregularity of the pulse, dimness of vision, dilated pupils, lethargy, prostration, convulsions, and coma. In two instances death occurred within twenty-two hours. The appearances found afterwards have been chiefly congestion of the cerebral vessels, and slight inflammation of the stomach.

Digitalin has acquired a certain importance from the trial and execution of De La Pommerais for poisoning the widow Pauw by its means. The facts were altogether inconsistent with his innocence, and though digitalin was not separated from the woman's body, yet extracts of the vomited matters killed dogs with the symptoms of poisoning by digitalis. The extracts obtained from the stomach and bowels did not prove fatal to these animals. Tardieu and Roussin, who were engaged on the case, came to the conclusion that the woman had been poisoned by some vegetable poison, probably digitalin. The woman's symptoms, which were not, however, carefully noted, were violent vomiting and extreme depression.

TREATMENT.—In addition to the administration of emetics and castor oil, some infusion containing tannin, as strong tea, etc., should be given as an antidote in poisoning by digitalis. Substances containing tannin render the digitalin inert. Strong tea or coffee, with brandy, will likewise be needed, to lessen the depression and exhaustion.

TOBACCO (Nicotiana tabacum).—All parts *of this plant* are very poisonous. An infusion

of the leaves, exhibited as an enema, has, on several occasions, speedily proved fatal. Persons in attempting to acquire the habit of smoking often suffer from severe nausea, vomiting, great prostration, and insensibility; while in some instances more severe effects have ensued. Symptoms very much resembling those of apoplexy have also been produced by the excessive use of snuff. A celebrated French poet died in fourteen hours from swallowing the contents of his snuff-box, which had been mixed with his wine as a joke. Snuff or tobacco is also sometimes used for drugging persons with a view to nefarious purposes, as robbery and rape.

Nicotin, the alkaloid of tobacco, is as deadly a poison as prussic acid. It is an acrid, volatile, oily liquid, of a pale amber color, smelling strongly of tobacco. A chemist was seen by one of the attendants at the Museum in Jermyn Street in the act of falling forward out of a water-closet in which he had concealed himself. The attendant raised him up, and with the aid of another man endeavored to carry him to a table, but he heaved a deep sigh and died in their arms. The appearances afterwards found were great congestion of the membranes of the brain and a dark fluid state of the blood.

The only other important case of poisoning on record with this drug was that of Bocarmé. This man, a Belgian count, studied chemistry, apparently with a view to the preparation of this substance, made it in quantity, and with

the help of his wife, poisoned her brother. The count was condemned and executed. M. Stas was engaged to search for the poison, and thus was introduced his process, so often referred to.

LOBELIA INFLATA (Indian Tobacco).—This plant is a native of North America; and its powdered leaves and seeds have been much used as a remedy for asthma. Its effects in many respects strongly resemble those of tobacco. In one instance, in which a quack prescribed a dram of the leaves, pain, vomiting, unconsciousness, feebleness of pulse, and contraction of the pupils supervened, and death occurred in thirty-six hours. Ignorant impostors, calling themselves "medical botanists" (more appropriately known as "Coffinites"), have poisoned several simple individuals, both in England and America by physicking them with this mischievous and powerful drug.

COLCHIUM (Colchicum autumnale, Meadow Saffron).—This plant grows in the most damp meadows. Its noxious properties are due to the active principle **Colchicin**, which in its effects is allied to that contained in white hellebore, **Veratria**. In two instances less than half a grain of colchicin proved fatal to adults.

WHITE HELLEBORE (Veratrum album) is a poisonous plant which, when taken internally, has caused violent sickness, purging, dilatation of the pupils, great prostration, and lowering of the heart's action, cold sweats, convulsions, and death. At the same time it is

powerful in relieving pain. Its properties are due to **veratrin,** an alkaloid, which may also be prepared from the seeds of Asagræa officinalis, or Cevadilla seeds. Veratrum viride acts in a similar manner.

Emetics, purgatives, and stimulants, are the means to be employed to prevent death in poisoning by any of these vegetable substances. They all produce extreme depression, hence stimulants must be freely used.

DERIVATIVES FROM COAL-TAR.—A number of interesting products have been obtained by the destructive distillation of coal-tar, having certain common properties, among which their antipyretic and antiseptic powers are the most conspicuous and important. Chemically they are derivations of **benzene,** C_6H_6. The most important of these bodies are **antipyrin, antifebrin, phenacetin** and **salicylic acid,** but the list is being constantly increased.

ANTIPYRIN.—Prepared by a complicated (patented) process, by the destructive distillation of coal-tar. A grayish-white crystalline powder of a bitterish taste; partially soluble in water, less so in alcohol, ether and chloroform. It gives an intense red color to ferric chlorid, and a beautiful green with nitric acid. It is a powerful antipyretic, and general reliever of pain (analgesic), also diaphoretic. Very much used in rheumatism, neuralgia and headache. Death has resulted from large overdoses, preceded by collapse and cyanosis.

ACETANILID.—Known also by the name **antifebrin.** Obtained by the action of glacial

acetic acid on anilin. A white crystalline substance, odorless; has a bitter taste, slightly soluble in water, more so in alcohol, ether and chloroform. Like antipyrin, this is powerfully antipyretic, analgesic and antispasmodic, producing in full doses cyanosis of the face and extremities; overdoses occasion a peculiar discoloration of the blood due to the formation of methemoglobin. Acetanilid is a common ingredient of "headache powders."

PHENACETIN.—A white crystalline powder, analogous in chemical constitution to antifebrin; no taste; slightly soluble in water, more so in alcohol and glycerin. It is a very efficient antipyretic and antineuralgic, and leaves no unpleasant after effects. Dose, gr. x to xx.

SALICYLIC ACID.—Made by treating a solution of carbolic acid in caustic soda with carbonic acid, at a moderate heat. It is either crystalline, or in the form of a dull, white powder; has a peculiar odor and taste. Partially soluble in water, more so in alcohol or glycerin. It is a powerful antipyretic, especially useful in acute rheumatism, either alone or as a salicylate of sodium. It produces much sweating. Overdoses are dangerous, causing heart failure and mental disturbance, with delirium and nervous prostration. Death results from respiratory paralysis.

SALOL is a derivative of salicylic acid. It is a white crystalline powder, and similar in its effects to the former.

Many other synthetic products are liable to cause poisoning such as pyrogallol, betanaphthol and naphthalene, but experience is too limited to furnish definite data for diagnosis or treatment. In general, free washing out of the stomach and the administration of remedies addressed to the most serious symptoms will be the best procedures.

CHAPTER XXXIII.

ASPHYXIANTS.

NOXIOUS GAS, PRODUCING NEUROTIC SYMPTOMS BY MEANS OF BLOOD POISONING.

THE most important of these asphyxiant noxious gases are carbon oxid, carbon dioxid, hydrogen sulphid and coal gas.

CARBON MONOXID, Carbonic oxid, is a much more dangerous poison than is carbon dioxid, but poisoning with it in a pure state is rare. It constitutes an ingredient in most vapors produced by burning coke or carbon, especially if the combustion is imperfect, as in poisoning by the vapor of burning charcoal. It is an abundant ingredient in the modern illuminant, water-gas. It forms with the coloring matter of the blood a remarkably stable compound of a light-red color; in point of fact it has been supposed to be the impossibility of exchanging carbon monoxid for oxygen in the lungs which causes death. After death the blood is bright red in hue, and gives a peculiar spectroscopic appearance.

The treatment of carbon monoxid poison-

ing has not been satisfactory. Experiments on animals have indicated that transfusion of blood may succeed.

CARBON DIOXID, CARBONIC ACID GAS.—This heavy inodorous gas is the cause of numerous accidents, owing to the variety of sources from which it is produced. It is formed from burning fuel, from the calcination of limestone or chalk, and it is a product of respiration. It is diffused through wells, coal-mines, and caverns. During fermentation it is largely given off, and accumulates in beer vats. The vapor of charcoal partly owes its poisonous properties to carbonic acid gas, as does that arising from lime, and brickkilns.

In this country suicides rarely resort to the vapor of charcoal to accomplish their ends: in France they very frequently do so.

SYMPTOMS.—In its pure state this gas causes immediate death by asphyxia. When sufficiently diluted to be inspired it acts by absorption or arrest or diffusion, giving rise to giddiness, headache, vomiting, a tendency to sleep, and loss of muscular power. The heat of the body is gradually lost, and the limbs are unusually flexible. The countenance gets livid, the respiration becomes stertorous, and complete insensibility ensues; while the heart's action, which was at first rapid, soon ceases.

POST-MORTEM APPEARANCES.—The body is generally swollen and livid, especially about the face. The countenance is not always *bloated, sometimes* being calm and pale. The *limbs are often rigid.* The right cavities of

the heart, the lungs, and large veins, are found gorged with venous blood; while the brain and its membranes are usually very vascular, and occasionally there is serous effusion.

TREATMENT.—Prompt removal to the pure air, cold affusion, and stimulating applications to the chest and extremities, are the best means for resuscitation. If the countenance is bloated, venesection may be performed. Artificial respiration, galvanism, and the inhalation of oxygen gas, have been found useful.

HYDROGEN SULPHID—SULPHURETTED HYDROGEN.—This gas is a very active poison, but from its offensive odor (resembling that of rotten eggs) it is not so liable to be accidentally inhaled as is carbon dioxid. It is usually met with combined with other gases, resulting from the putrefaction of animal matter. When breathed in a diluted state, it speedily produces insensibility and death. Workmen long engaged in drains and sewers, or in any atmosphere contaminated with hydrogen sulphid, suffer from giddiness, nausea and weakness.

In acute cases there will be little hope of recovery, unless the individual can be quickly removed into the open air, and stimulants, etc., applied. Chlorin, well diluted with common air, might be employed, as it breaks up the gas.

COAL GAS.—Two distinct mixtures may be indicated by this term; the gas escaping from burning fuel (through defective flue, for instance) and unburnt illuminating gas, made

from coal. The former will contain carbon dioxid, carbon monoxid with a little sulphur dioxid; the latter is principally hydrocarbous with some carbon monoxid. The symptoms produced by gas from burning fuel, when mixed with air and inhaled, are those of asphyxia. If the person breathing it should be roused before a fatal quantity has been inhaled, the chief effects will be intense headache, labored and oppressed respiration, quickened action of the heart, sickness, and great loss of power.

In 1841, a whole family in Strasburg was poisoned by being in an atmosphere contaminated with coal gas, for forty hours. Of the six members, four were found dead, while the father died in twenty-four hours; but the mother recovered. The gas escaped from a pipe which passed under the cellar of the house where this family resided. The poisonous action of illuminating gas is usually due to carbon monoxid, for the effects of which see under that substance.

CHAPTER XXXIV.

ABORTIVES.

SUBSTANCES PRODUCING ABORTION.

THIS group, though far from a natural one, is nevertheless convenient. It comprehends many substances, first among which comes

ERGOT OR RYE (Spurred Rye, Secale cornutum).—*The grain* of wheat, barley, oats and rye, *is apt to* be attacked by a parasitic fun-

gus which imparts to it specific properties. This substance has the power of inducing contraction of unstriped muscular fiber, especially in the smaller arteries and uterus. Ergotized grain, in full doses, gives rise to lassitude, headache, nausea, and diarrhea. From small quantities, frequently repeated, gangrene of the extremities has resulted. The peculiar influence of ergot on the muscular coat of the uterus renders this agent a valuable medicine when we wish to induce powerful contractions; but in the hands of the ill-intentioned it is frequently used to procure abortion; but its action in this way is far from certain, and at all times dangerous.

SAVIN AND ITS OIL are irritant poisons, only indirectly affecting the uterus; nevertheless, they not unfrequently are used to induce miscarriage.

OIL OF TANSY has also been employed in America as an abortive agent, and in three instances, at least, has caused death. The use of these oils is extremely dangerous, usually causing fatal inflammation without the intended abortion.

The **YEW (Taxus baccata)**, which has acquired in certain districts a reputation as an abortive, acts as do some others, by producing irritation of the bowels, and so communicating a kind of stimulus to the uterus. The leaves and berries of the yew have both proved fatal, commonly with irritant symptoms; but those of coma have also been observed.

In the United States extract of Cotton-root *has* a reputation as an abortive.

APPENDIX.

I. BITES OF VENOMOUS REPTILES.—Accidents from serpents' bites rarely happen in built up places, but are of frequent occurrence in frontier lands.

On the morning of the 20th October, 1852, one of the keepers at the Zoölogical Gardens in the Regent's Park was wounded by a cobra, which he had removed from its cage and was playing with. For twenty minutes after the animal bit him at the root of the nose no peculiar symptoms were manifested, and the part was merely bathed with water. Forty minutes afterwards the man was admitted into University College Hospital, his face then being livid, respiration impeded, and the power of locomotion imperfect. He pointed to his throat as the sea of pain, but could not speak, and was unable to swallow. Artificial respiration was employed for fifty minutes, and subsequently galvanism; but stupor rapidly succeeded to faintness and the patient died comatose fifty-five minutes after admission. The chief appearances found on dissection were an unnatural fluidity and blackness of the blood, with great congestion of the lungs and spleen.

The **treatment** of the bites of venomous reptiles must be local and constitutional. Immediately the wound is inflicted it should be sucked freely and perseveringly. If the patient *is too* faint to do this for himself, a bystander

may fearlessly help him; for it is well known that, provided there is no crack about the lips or tongue, these poisons may be even swallowed with impunity. At the same time a ligature is to be placed around the limb, above the wound; or if this be impossible, from its situation, the textures around are to be compressed. Then the bitten part may be excised; or it may be destroyed by the actual cautery. The local application of strong solution of potassium permanganate or bleaching powder (chlorid of lime) has been highly recommended.

The constitutional remedies are derived chiefly from the class of diffusible stimulants. Aromatic spirits of ammonia may be administered in the proportion of two drams to an ounce and a half of water. Alcohol is not now regarded as applicable except in small doses. Artificial respiration, warm applications and mild surface stimulation are to be used as indications for them arise.

II. BITES OF RABID ANIMALS.—Many instances of death from the bites of mad dogs have recently been recorded, and accordingly it may not be amiss to say a few words here as to the mode of dealing with such and such-like wounds. This is briefly as follows: The tissues round the seat of injury are to be compressed by a ligature or otherwise, to prevent absorption. Then the wounded part is to be excised as soon as possible; taking care to remove every portion touched by the animal's teeth, and to obtain a clean raw surface. The wound should then be thoroughly washed by

a stream of water, long poured over it, and lunar caustic afterwards applied. Mr. Youatt preferred silver nitrate, freely used, to every other caustic; and he also recommended that after each application the wound should be quickly healed, though many authorities advise that it be kept open by irritating ointments. Some prefer strong nitric acid applied directly to the wound. Carbolic acid in strong solution might be similarly applied, but does not admit of such a ready neutralization as a strong mineral acid. As these operations are very painful, there is no objection to the patient being placed under the influence of chloroform. He should afterwards be assured that everything has been done to prevent any subsequent mischief; and to give him greater confidence, and to banish all fear from his mind, it may be as well to administer ammonia and bark for some days after the accident.

Although some high authorities deny the existence of such a disease as **hydrophobia,** there can be no question that many cases do occur where the most terrible effects take place after being bitten by a mad dog, or other rabid animal; moreover, these have hitherto resisted all attempts to relieve them. The Pasteur method of **inoculation** seems to be attended with success when instituted early.

III. STINGS OF INSECTS.—The effect of the stings of bees is usually slight, and the pain quickly passes off. In some instances, *however,* there have resulted swelling and ery-

sipelas, or suppuration, or gangrene, or even death.

The stings of wasps, hornets, and still more of scorpions, are more serious.

Again, serious results may be brought about by the swelling consequent on such stings, and the bites of ants and other insects in situations where swelling is dangerous. Thus, a youth, sixteen years of age, was drinking from a bottle, when a wasp, which he had not seen, got into his throat and wounded him. He died, suffocated by the swelling.

For these stings and bites ammonia is the best remedy, but soap or any alkaline substance will often give relief. Sometimes, when the bees have extracted their honey from poisonous plants, injurious results have followed its use.

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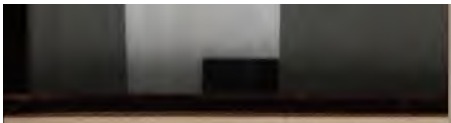

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